ROAD CONSTRUCTION
GENERAL SPECIFICATIONS

COMMON WORKS	1100 – 9300
CLEARING, GRUBBING AND REMOVAL WORK	1100
FOUNDATION WORK	1200
DRAINAGE AND SEWERAGE	1300
CONSTRUCTION OF ROAD FORMATION : ROCK	1400
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NATIONAL BOARD OF PUBLIC ROADS AND WATERWAYS 1969

NATIONAL BOARD OF PUBLIC ROADS AND WATERWAYS

R O A D C O N S T R U C T I O N

GENERAL SPECIFICATIONS

COMMON WORKS 1100 - 9300

1969

ROAD CONSTRUCTION

General Specifications

C O M M O N W O R K S 1100 - 9300

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ARRANGEMENT OF TRAFFIC DURING CONSTRUCTION AND MAINTENANCE

GENERAL

General Regulations

Regulations concerning public roads and public traffic are mainly included in the Public Roads Act (243/1954), the Public Roads Statute (482/1957), the Road Traffic Act (143/1957), the Road Traffic Statute (331/1957), the Traffic Sign Decision of the Ministry of Communications and Public Works (384/1957 and 458/1968), the Motor Vehicle Statute (330/1957) and in the Decision of the Ministry of Communications and Public Works Concerning Enforcement of the Motor Vehicle Statute (392/1957).

The road shall be constructed and maintained as well as other works in or near the road area carried out in such manner that no danger is caused to public traffic or labour. Works on the road shall not unduly impede public traffic.

Great care shall be taken in the arrangement and operation of construction traffic. Traffic shall be controlled in an efficient, expedient and uniform manner. Traffic arrangements shall be altered as the work proceeds in such manner that they always conform to prevailing conditions.

Instructions

These specifications for the arrangement and control of construction traffic shall be applied in all road construction, improvement, maintenance and other works on public roads and in such work carried out in the vicinity of public roads as may cause danger to or impede traffic or as may be exposed to danger by public traffic. The specifications may also be applied for traffic arrangements required in accident and damage cases and in other such situations. Traffic arrangements required by each site shall be as set forth on these Specifications.

On sites where public traffic is not allowed as well as on job site roads used for hauling gravel etc the regulations given

herein shall also be applied to the extent deemed necessary from the point of view of the safety and operation of construction traffic and of the protection of labour.

Responsibility for Traffic Arrangements

The road keeper shall be responsible for traffic arrangements on public roads. In road construction work an agreement may be reached on transfer of this responsibility to the Contractor. On the basis of the permit granted by the road authority the Contractor shall be responsible for traffic arrangements required by works in or near the road area (excl. works related to road keeping) as set forth on the conditions of the permit. Each job site shall have a person responsible for the trafficability, traffic arrangements, traffic signs and for other safety measures of the road.

When the road is constructed by contracting, the Employer and the Contractor shall prior to the start of works make an agreement on traffic arrangements during construction. At this inital inspection agreement shall also be reached on the division of labour between the Employer and the Contractor, if both parties will work on the same road section simultaneously. The Contractor shall also give the name of the person answering for traffic arrangements. It shall furthermore be checked that the traffic signs and other equipment of the Contractor are sufficient and in conformity with specifications.

The Employer shall take care of his traffic arrangement duties and he shall control the measures taken for arrangement of traffic by the Contractor. Such control by the Employer shall not restrict or diminish the obligations of the Contractor. Should traffic arrangements prove inadequate and danger or undue detriment are caused to public traffic, construction works shall forthwith be suspended. The works may be resumed only when traffic arrangements have been made in full compliance with specifications.

ARRANGEMENT AND CONTROL OF TRAFFIC

General Arrangements

Job sites shall be located, work phases arranged and detour roads constructed in such manner that public traffic can as far as possible be eliminated on road sections being constructed. Roads used by public traffic shall always be kept in a condition satisfactory to traffic. Maintenance of an old road section used by public traffic shall not be neglected in connection with the construction of the road. As far as possible construction traffic shall be conveyed to roads other than those used by public traffic.

On a road under construction public traffic may be allowed "at own risk", if it is considered that traffic will not cause danger to remaining works and that the arrangement of traffic is expedient from the point of view of public traffic. On such a road section all dangerous spots and job sites shall be indicated by traffic signs as separate job sites.

Traffic and Road Signs

Traffic shall be controlled by means of traffic signs and additional plates conforming to the Traffic Sign Decision of the Ministry of Communications and Public Works and by means of road signs confirmed by the National Board of Public Roads and Waterways. The structure, colour and quality of traffic signs shall be approved by the National Board of Public Roads and Waterways. All traffic signs used on sites shall be either illuminated or reflectorized.

As a rule traffic signs shall be placed outside the roadway on the right-hand side of the road. On dual carriageway roads and, if necessary, on other roads, traffic signs shall be placed on both sides of the road. Traffic signs shall be placed at right angles to the road at a distance of 1...2 m from the edge of the roadway or at a distance of 0,5...1,0 m from the edge of the shoulder. The lower edge of warning and prohibition signs or sign groups shall be 1,5...2,2 m above the road surface. Traffic signs shall be placed visibly in such manner that they

will not cover one another when viewed from the direction of the road and that they will not form a visual obstacle to traffic. Traffic signs shall be attached into good posts or frames. The sign posts shall be in a vertical position. All signs on the site shall be kept tidy and in good condition,

Special attention shall be given to the fact that all signs deemed necessary are used on the site. Superfluous signing not based on actual conditions shall not be allowed and unnecessary traffic signs shall be removed forthwith. When no work is being carried out, also in the evenings and during weekends, superfluous signs shall be temporarily removed or covered. Covering shall be effected by means of device planned for the purpose. Sign covers shall be such that they will not be displaced by wind or rain.

The following traffic and road signs are the most common ones used on road construction sites (Fig. 1, Appendix 1):

Traffic signs

Road Narrows (I Ad)
Road Works (I Af)
Danger (I Ai)
Traffic Signal Ahead (I Ak)
Two-Way Traffic (I Am)
Slippery Road (I An)
Loose Stones (I Ao)
Closed to All Vehicles (II Aa)
No Entry for All Vehicles (II Ab)
Overtaking Prohibited (II Ad)
Speed Limit in kms (II A oa)
End of Speed Limit (II A pa)
Priority Road Ahead (II As)
Stop at Intersection (II At)
Priority to Be Given to Vehicles Coming from the Opposite Direction (II Au)
Direction to Be Followed (II Ba)
Divisional Island (II Bc 1 and II Bc 2)
Priority over Traffic Coming from the Opposite Direction (III Am)

Road Signs

Sign for Road Construction Site
Direction Sign of Site
Deviation
Direction Arrow
Background Sign
Go Slow -Sign

Only such additional plates as are approved by the National Board of Public Roads and Waterways and as conform to the Traffic Sign Decision may be fixed into traffic signs. Additional sign plates with a legend should be bilingual depending on language conditions in the commune concerned. The use of bilingual additional plates should however be avoided.

Warning Signs

The sign "T r a f f i c S i g n a l A h e a d " (I Ak) shall be used always when traffic is controlled by means of temporary traffic signals. If instead of signals traffic is controlled manually, the sign "R o a d N a r r o w s " (I Ad) with an additional plate "Ready to Stop" ("Valmiina pysähtymään"- "Var beredd att stanna") shall be used.

The sign"S l i p p e r y R o a d " (I An) shall be used when the roadway is temporarily slippery owing to surfacing works, dirtying or similar reason. A warning for a recently laid surfacing shall be indicated by means of this sign provided with an additional plate with legend "New Surfacing" ("Uusi päällyste" - "Ny beläggning"). The sign may be removed when the surfacing has worn into a condition in which no slipperiness is observed.

The sign "L o o s e S t o n e s " (I Ao) shall be used when owing to construction, earthmoving or maintenance operations stones detrimental to traffic are found on the road surface (particularly on oil gravel roads).

The length of the road section covered by the warning sign shall be indicated by an additional plate. The danger sign shall be repeated after every intersection of a public road. When a danger sign (e.g. Road Works -sign) has an explaining function

in connection with i.e. a speed limit sign, it shall be repeated with the speed limit sign at an interval of at least 2 km.

Prohibition Signs

The sign " O v e r t a k i n g P r o h i b i t e d " (II Ad) may be used in the countryside only with the permission of local police authorities.

The permit for the use of " S p e e d L i m i t " signs (II Aoa) shall be applied from the Country Board (in the countryside), from the Municipal Court (in boroughs) and from the Bench of Magistrates (in towns).

In cases when the speed limit concerned is lower than 50 kmh, the authority will submit its decision for confirmation to the Ministry of Communications and Public Works. In applying for a speed limit the value and the length of the limit shall be carefully considered and no unjustified speed limits shall be used. A speed limit of 50 kmh or lower (30 kmh) justified by road construction operations can be used only at locations where work is carried out or at other dangerous or specially low-standard locations. Long, continuous 50 kmh-speed limit sections shall be avoided. Ending of the speed limit zone shall always be indicated separately by using the sign "E n d o f S p e e d L i m i t " (II Apa). On minor short-time sites signs " G o S l o w " ("Aja hitaasti" - "Kör sakta") may be used instead of speed limit signs.

The signs " P r i o r i t y t o B e G i v e n t o V e h i c l e s C o m i n g f r o m t h e O p p o s i t e D i r e c t i o n " (IIAu) and " P r i o r i t y o v e r T r a f f i c C o m i n g f r o m t h e O p p o s i t e D i r e c t i o n " (III Am) shall always be used together in such manner that they are placed at the opposite ends of the section concerned.

A prohibition sign shall be repeated after every public road intersection. Speed limit and "Overtaking Prohibited" -signs shall be repeated at an interval of not less than 2 km. The length of the road section concerned shall always be indicated by an additional plate.

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Right-of-Way

A vehicle moving on a road under construction and open to public traffic shall stop and yield to vehicles moving on intersecting public roads. Excluding minor sites this shall be indicated by using the sign " S t o p a t I n t e r s e c t i o n " (II At).

At an intersection of a road under construction open to public traffic and a main or secondary road the sign "P r i o r - i t y R o a d A h e a d " (II Ao) or the sign "S t o p a t I n t e r s e c t i o n " (II At) shall be used on the road under construction depending on visibility.

At an intersection of a road under construction open to public traffic and other public road than main or secondary road, the right-of-way may be arranged in an expedient manner by using the above traffic signs.

At an intersection of a road under construction open to public traffic and a private road, the traffic sign II At may be used on the private road to indicate the obligation to stop.

Signing Road Construction Sites

Public traffic on road sections under construction shall be conducted so distinctly that there will be no risk of mistake. Shorter detours with no misleading intersections shall be indicated by means of deviation signs and direction arrows. Long detours shall be signed with destination signs and signs of the road construction site supplementing actual deviation signs (Fig. 11 and 12, Appendix 5).

A road under construction open to public traffic "at own risk" shall be signed by destination signs and signs of the road construction site.

In that case the "Road Works" sign (I Af) placed on the road under construction close behind the intersection of the public road shall be provided with an additional plate "Driving at Own Risk" ("Ajo sallittu omalla vastuulla" - "Körning tillåten på eget ansvar").

The size of the legend used for detours and roads under construction shall be the same as will be used on the road after its completion.

B a r r i e r D e v i c e

In order to mark the area under construction and to separate the same from the area reserved for public traffic, guard fences, road barriers, bollards, reflective wires and traffic cones shall be used.

The colour pattern of barrier devices shall be such that yellow and red parts alternate. The surface of barrier devices shall be reflectorized or provided with adequate reflective device. Barrier device shall have a firm and clean structure (Fig. 2, Appendix 1).

It shall be possible to attach necessary flash lamps, traffic and road signs into barrier devices.

The road may be completely closed by means of guard fences or road barriers placed at right angles to the road. The fences and barriers shall then be provided with lamps showing fixed red light. There shall be at least one lamp for each closed traffic lane in one direction.

The road may also be closed obliguely by using quiding barriers or bollards. Guiding devices shall be provided with necessary flashing beacons and with "D i v i s i o n a l I s l a n d" signs. The obliqueness of guiding device in relation to the road shall be at least 1:5.

Part of the roadway shall be closed either at right angles by barriers or obliquely by barriers or bollards.

In the longitudinal direction the portion under construction shall be closed by means of barriers or bollards and reflective wires. Dangerous trenches shall be protected from each direction by means of guard fences or road barriers.

Part of the roadway may be closed temporarily by day by using traffic cones (i.e. in connection with surfacing and carriageway marking operations).

Traffic Through Narrow Spots

Through a road section narrowed into a single-lane road traffic shall be conducted so that the impediment to the safety and the operation of traffic will be reduced to a minimum.

On low-volume roads or during off-peak periods general yielding rules and regulations may be considered sufficient on short narrowed road sections provided, however, that the narrow spot is entirely visible in good time. In other cases traffic shall be conducted through by means of special traffic signs, traffic signals, manual control or by arranging a sufficient number of passing places. Regardless the method of traffic control the narrowed road section shall always be indicated by danger signs "Road Narrows" (I Ad).

The signs "Priority to Be given to Vehicles Coming from the Opposite Direction" (II Au) and "Priority over Traffic Coming from the Opposite Direction" (III Am) shall be used only if they are considered to contribute considerably to the safety and operation of traffic. On low-volume roads where vehicles rarely meet at the narrow spot the use of signs is not necessary. If on the other hand traffic volumes are high and/or the single-lane section is long, the superfluous use of these signs may form an obstacle to traffic coming from one direction. When signs are used the ends of the narrow section shall be fully visible and the road section shall be visible in good time to allow for any stopping.

Traffic signals shall normally have three-colour faces, but with a special permission also two-colour signals may be used except at intersections. The operator of traffic signals shall be able to check approaching vehicles behind both signal installations. If this is impossible, several persons shall be employed and they shall keep contact, i.e. with radio telephones. Stopping places shall be arranged so that drivers are able to observe them in good time and to stop their vehicles before the end of the vehicle queue.

Traffic may also be controlled manually. The person conducting traffic may stop traffic by using a sign, dia 200 mm, fixed into a pole arm "Closed to All Vehicles"

(II Aa) or by using a normal-size sign " N o E n t r y f o r A l l V e h i c l e s " (II Ab) fixed into a sign pole and turned according to the change of driving direction. In other respects arrangements shall be as set out for cases when traffic signals are used.

If no arrangements have been made for traffic control, longer narrowed road sections shall be provided with a sufficient number of passing places (as a rule only when the volume of traffic is less than 1 500 vehicles per day). Passing places shall be fully visible from one another and the distance shall not exceed 300 m. A sufficiently wide area (preferably more than 6,5 m) shall be reserved at the passing place on a length of 30...40 m. Passing places shall be indicated by means of the sign "Passing Place" (III Ae).

S i t e V e h i c l e s

According to Clause 7 of Para 10 of the Decision on the Enforcement of the Motor Vehicle Statute a rotating or flashing yellow beacon mentioned in Clause 4 of Para 10 of the Decision shall be attached into a vehicle equipped with a device increasing the width of the vehicle or wider than the vehicle, or into a vehicle equipped for road keeping operations or to be used in work on the road. The beacon shall be used in cases when the movement, turning, stopping, entering to or departure from the road in poor visibility contrary to general traffic rules and regulations, or the width or the length of the vehicle may endanger other traffic. The same regulations concerning the use of beacons shall also be applied for tractors, power-driven working machines and power-driven equipment.

The supervisory staff of the site shall control the operation of vehicles used on site to prevent any undue detriment or danger to other traffic. Special notice shall be given to the obeyance of speed limits and to traffic on roads with loose chippings on the surface. Vehicles, working machines and equipment shall not unnecessarily be parked or kept on the roadway used by public traffic. During suspensions vehicles, machines and equipment shall, if possible, be taken outside the road area so that there will be least possible impediment to traffic.

Labour

If possible, all labour of the site moving frequently on the portion of the road used by public traffic shall wear distinct, reflectorized garments, waistcoats, belts or caps. Since the use of protective garments cannot be made obligatory, the supervisory staff shall keep informing labour in the matter and encourage the use of such garments on a voluntary basis.

VARIOUS SITE CASES

Dual-Carriageway Roads

Road construction sites shall be signed as set forth on Fig. 3, 4 and 5 in Appendix No. 2 and 3. If the entire roadway has to be closed, traffic shall be conducted across the central reserve at special crossings. Special attention shall be attached to the safety and operation of traffic on motorways.

Single-Carriageway Roads

Road construction sites shall be signed as set forth on Fig. 6, 7 and 8 in Appendix No. 3, 4 and 5. When the roadway is closed partially, the width of the portion reserved to traffic shall be arranged so that it clearly indicates whether the road is open for one-way traffic (width normally less than 4.5 m) or for two-way traffic (width generally more than 6,0 m). The width of road reserved for public traffic shall be not less than 2,5 m.

Construction Work Outside Roadway

When work impeding traffic is carried out outside the roadway area the arrangements required by the site shall be as set forth on Fig. 9 in Appendix No. 5.

Work on Intersecting Road

Should work be carried out on an intersecting road so close to the intersection (normally closer than 70 m) that the site will impede turning traffic, vehicles on the first-mentioned road shall be warned as set forth on Fig. 10 in Appendix No. 5.

Measurements, Cable, Electricity and Other Works

When work other than that related to roadkeeping, such as excavating for sewers, laying of electricity cables etc. shall be carried out within or close to the road area, a permit shall be obtained from the District Office of the National Board of Public roads and Waterways. In applying for such a permit the plan for the arrangement of traffic shall be submitted. When planning such arrangements the specifications given herein for actual road works may be applied.

If the impediment caused by this work is of minor importance or of short duration the traffic sign "Road Works" (I Af) with an additional plate indicating the length of road section concerned may be used.

If the roadway shall be closed temporarily, e.g. because of placing measuring tape, a cable etc across the road, traffic may be stopped by using a small (ø 200 mm) traffic sign " No Entry for All Vehicles " (II Aa) fixed into a pole arm. The visibility at the spot shall be absolutely sufficient.

Surfacing Works

In addition to the above specifications for marking road construction sites, the following shall be taken into account when surfacing sites are marked and public traffic managed.

If work is carried out on a road section from which the old surfacing shall be removed, the removal team shall proceed ahead of the surfacing team in such manner that the length of road section inconvenient to traffic is not more than 3 km on heavily trafficked roads (over 3 000 veh./day) and in general not more than 5 km and that the unbound base is not kept without a surfacing for more than two weeks. If the foundation has been prepared in winter, the road shall be kept in condition satisfactory to traffic until surfacing works are started.

When spots damaged by frost are repaired, surfacing operations should be carried out within one month from the repair works.

A traffic lane the old surfacing of which has been treated with priming agent before actual surfacing shall always be closed to public traffic until the priming agent has been covered with regulating mixture or with a new surfacing. The maximum permissible length of primed lane ahead of the road paving machine is 300 m.

Permits for the use of speed limits shall be applied for in good time before the start of surfacing operations from authorities concerned. In course of the work speed limit signs shall be moved in such manner that there are no undue speed limit signs on any road section. A speed limit of 50 kmh shall be used at the spreading spot and at other major project sites. A speed limit of 70 kmh may be used elsewhere if expedient from the point of view of work carried out on the section or of the condition of the road. The speed shall be restricted gradually on a length of 200 m from 90 kmh to 70 kmh and further down to 50 kmh. The 90 kmh speed limit may be omitted on slow and narrow roads.

When the road is entirely closed to public traffic for the time of surfacing operations, both the road to be surfaced and detours and by-pass roads shall be provided with adequate traffic signs. Detours or by-pass roads shall be effectively signed.

The slipperiness of the surfacing shall be indicated by means of the sign "Slippery Road" (I An) provided with the additional plate "New Surfacing" ("Uusi päällyste" - "Ny beläggning"). Signs may be removed when the surfacing has worn out into a condition where no slipperiness appears.

When in connection with oil or cut-back bitumen gravel works there are so much stones on the road that it may prove dangerous to traffic, the sign "Loose Stones" (I Ao) shall be used.

Deviating from the general instruction given in Item 1730 of the Specifications, on heavily trafficked roads, where pavement marking operations are common, markings shall be painted, after the relaying of the wearing course, within 1/2...1 week from the completion of the surfacing. During the time pavement markings are lacking the Employer shall place at the ends of the surfaced section traffic signs "Danger" (I Ai) provided with

the additional plate "No Pavement Markings" (" Ajoratamerkinnät puuttuvat" - "Körbanemarkering fattas"). During suspensions at weekends or discontinuations of work longer than 20 hours the conditions on the site shall be made if possible such that superfluous traffic signs and barriers required in surfacing operations can be removed so that traffic is not unduly restricted. In that case both spread lanes shall end at the same spot. Machines shall be removed from the road area for weekends and other long suspensions.

The Contractor shall be responsible for traffic signs, safety fences, traffic arrangements and traffic safety on the spots of the road section delivered to him for surfacing or closely connected with the performance of work. Consequently, the Contractor shall take care of traffic control on one-lane road sections, of the relocation of traffic signs in course of the work, of placing and transferring traffic signs and barriers required by the closure of the lane and of the removal of unduly restricting signs and barriers for the time of suspension.

M o v i n g W o r k s

These works are most frequently maintenance operations and they are generally carried out on completed roads where public traffic has got used to it. Therefore, the drivers of site vehicles and labour shall be most careful in their work. This work should be carried out when the volume of traffic is low. Traffic signs needed shall be placed as specified on the Traffic Sign Decision. Motor vehicles used shall be provided with yellow flashing beacons.

If maintenance operations are similar to permanent job sites as to extent and duration, markings shall be made as set forth above. Cases like this are, among others, grading that will considerably change the inclination of the road and the reconstruction of a clay gravel surface.

Labour carrying out carriageway marking operations on the road shall wear visible protective garments. The sign "Divisional Island" (II B c 1) shall be placed in the rear and in front of the marking machine indicating the side from which the machine may be passed. If the marking machine is followed by a truck

placing traffic cones on the road for the period of marking, the sign "Divisional Island" shall be placed in the rear of the truck. Such a sign shall also be used in the rear of the truck collecting traffic cones after marking operations. The sign "Divisional Island" shall also be placed in front of the foremost traffic cone. If traffic during marking is heavy, a vehicle provided with the "Divisional Island" -sign and a flashing beacon shall drive in front of the marking machine. When the edge line is being painted the "Divisional Island"-sign shall be placed behind the machine. The spot at which transverse markings are painted shall be closed and protected by applying the arrangements specified for a permanent job site. Marking of the carriageway shall be indicated to road users by using the "Road Works" -sign (I Af) with the additional plate "Painting of Carriageway Markings" ("Ajoratamerkintöjen maalaus" - "Målning av körbanemarkeringar").

Vehicles used in measurements of evenness, friction, bearing capacity or sight distance etc shall be equipped with the sign "Measurement". Should a vehicle of this kind travel in the middle of the road it shall have a flashing beacon and a "Divisional Island" -sign shall be placed in front and in the rear of the beacon.

On motorways, maintenance operations shall not be carried out during peak hours. All vehicles used shall have a flashing beacon in operation both by day and night. The flashing beacon on a tractor and other slowly moving vehicles and in a lorry towing a machine shall be in operation also when the vehicle is moving on the motorway to the site.

In normal road maintenance, vehicles may move on the roadway of the motorway only in the direction allowed for other traffic. The speed used in driving forward shall be as uniform as possible. When the work proceeds in stages, as in removal of snow, or similar, a vehicle with a "Road Works" -sign (I Af) provided with the additional plate "400 m" shall be used behind the working team. This vehicle shall be on the side of the road on which work is being done and drive as near the edge as possible.

B l a s t i n g

In connection with blasting operations the "Road Works" -sign (I Af) shall be provided with the additional plate "Blasting - Turn off the Radio" ("Räjäytystyö, sulje radiolähetin" - Sprängning, stäng av radiosändare") as specified on the Specifications for Blasting (Technical Safety Regulations No. 18 confirmed by the Ministry of Social Affairs).

Owing to blasting operations traffic entering the danger zone shall be stopped as set out in the decision of the State Council concerning the regulations to be followed in blasting (302/1965). Traffic shall be stopped using a red flag fixed in a pole arm by day and a red lamp in the dark or in poor visibility. The visibility at the place vehicles are stopped shall be good.

I n t e r s e c t i o n A r r a n g e m e n t s a n d C h a n g i n g a P u b l i c R o a d i n t o a P r i v a t e R o a d

If an existing intersection is removed or linking an existing road with the road under construction is not allowed, the spot from which the road is cut off shall be marked with a firm road barrier painted with colours of such barriers. Instead of a barrier, red and yellow guide posts, about 1 m in height, may be used, if the pedestrian route is to be preserved.

When owing to the intersection or other arrangements the route of an existing road is changed, the direction at the changed spot shall be indicated, if necessary, by means of background signs.

When an existing public road is changed into a private road in conjunction with improvement or construction work, the new private road shall be provided with the "Stop at Intersection" -sign (II At) placed at the intersection of the public and the private road.

Fig. 1 The most common traffic and road signs used in road works.

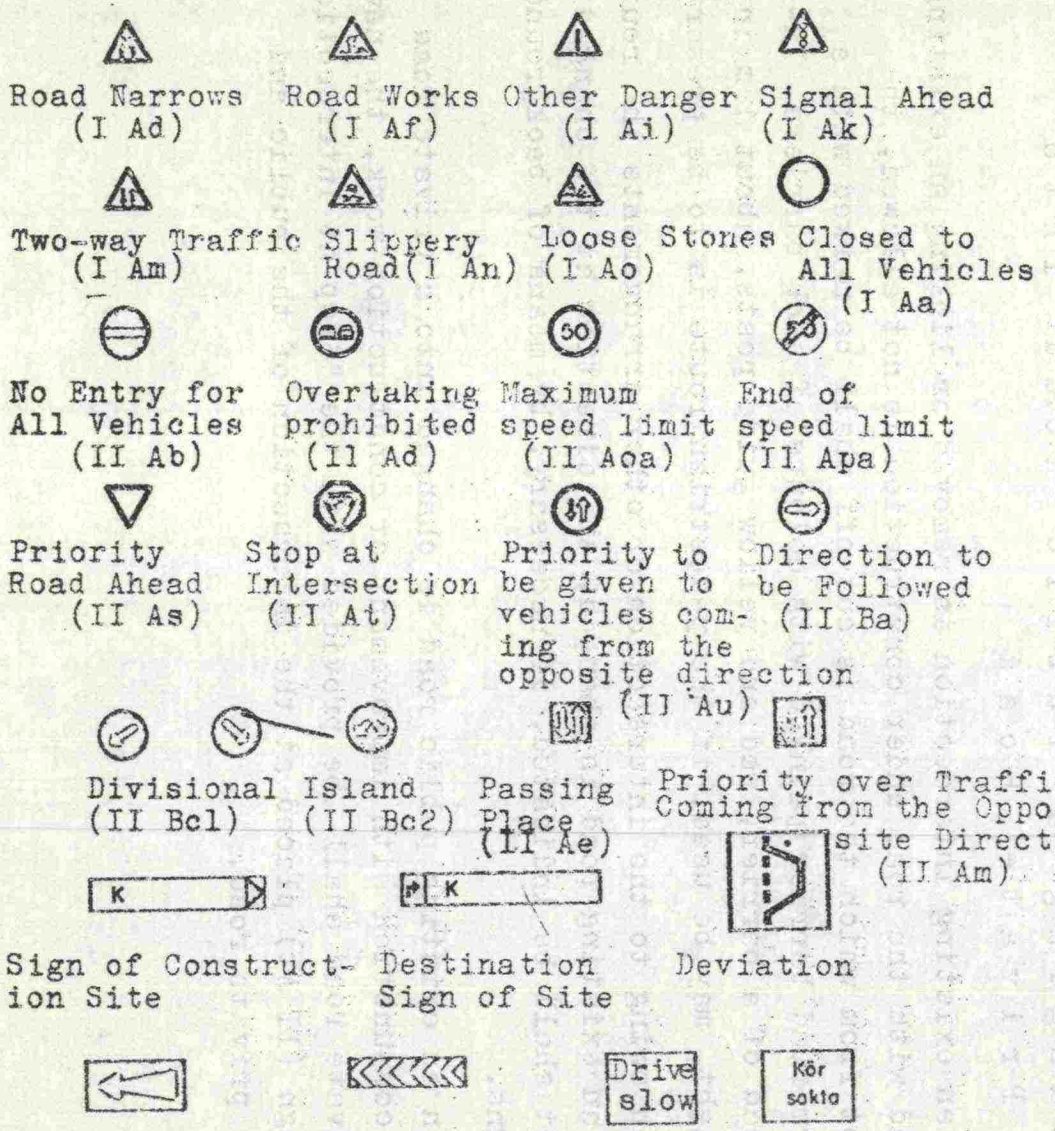
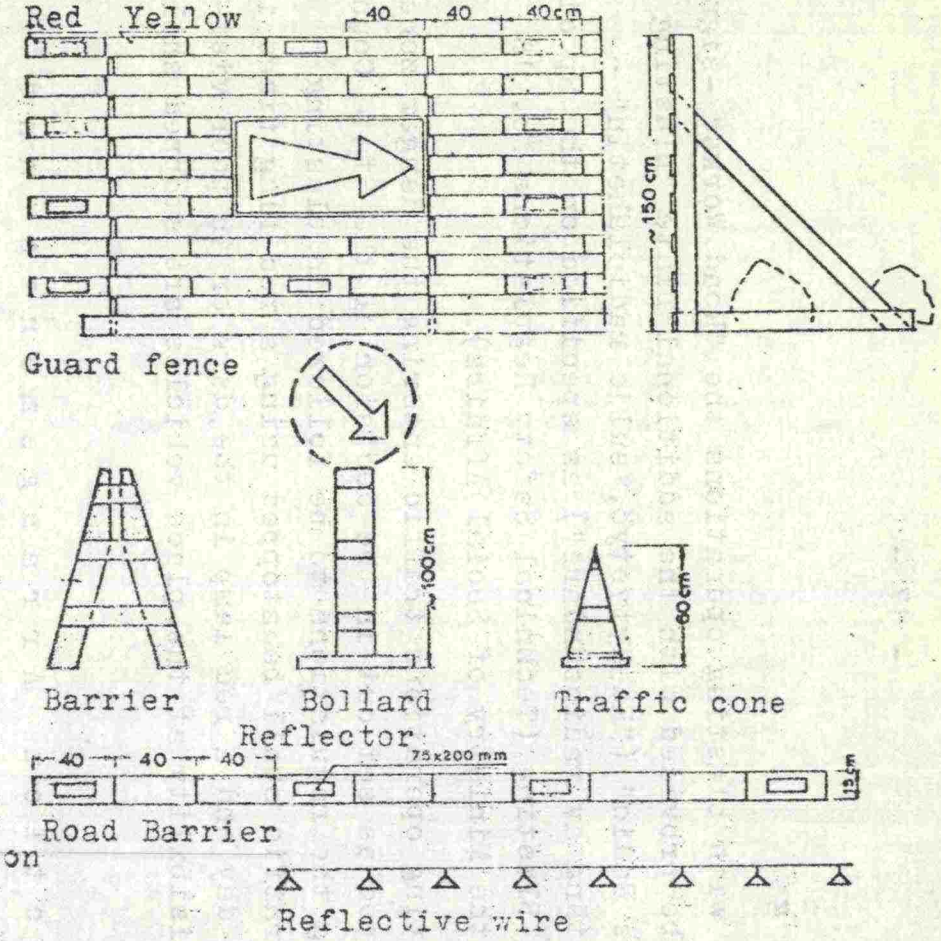


Fig. 2 Barrier Devices



Markings used in drawings

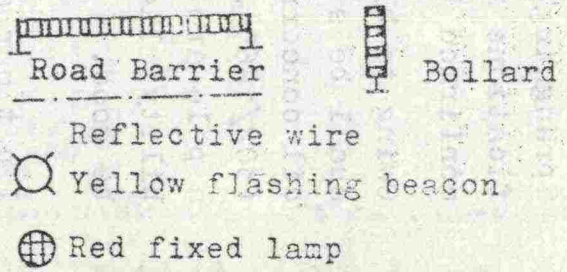
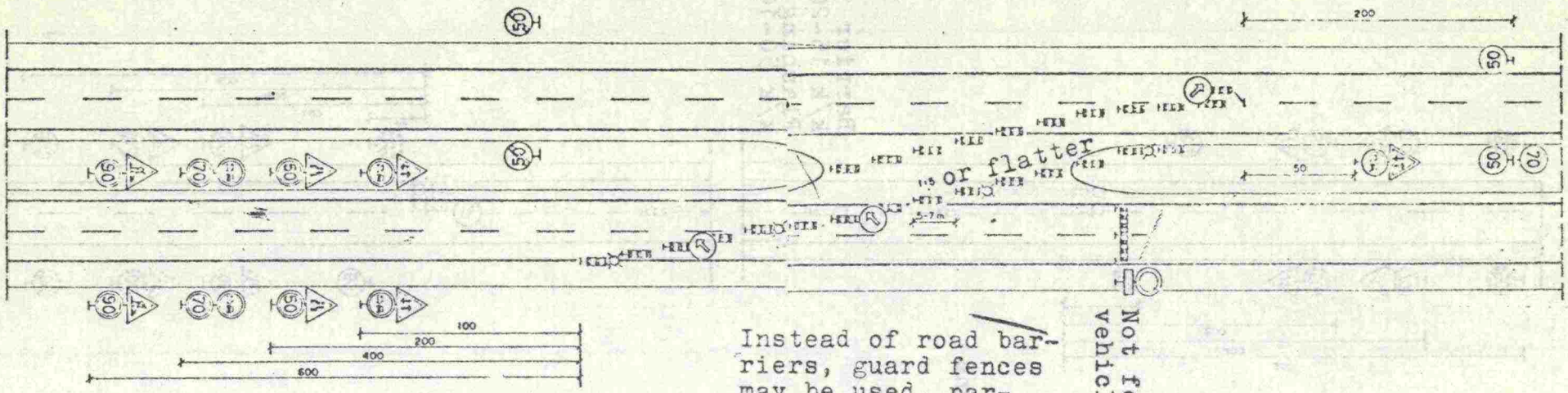


Fig.3 Dual carriageway road, carriageway closed



Instead of road barriers, guard fences may be used, particularly on long and permanent sites.

Not for site vehicles

Fig.4 Dual carriageway road, carriageway closed

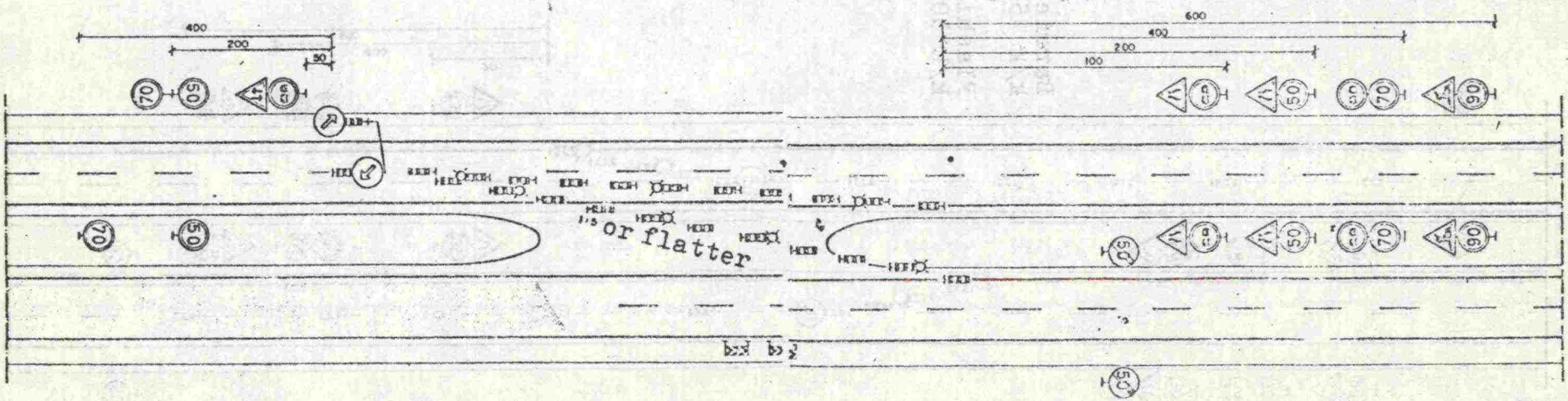


Fig.5 Dual carriageway road, lane closed

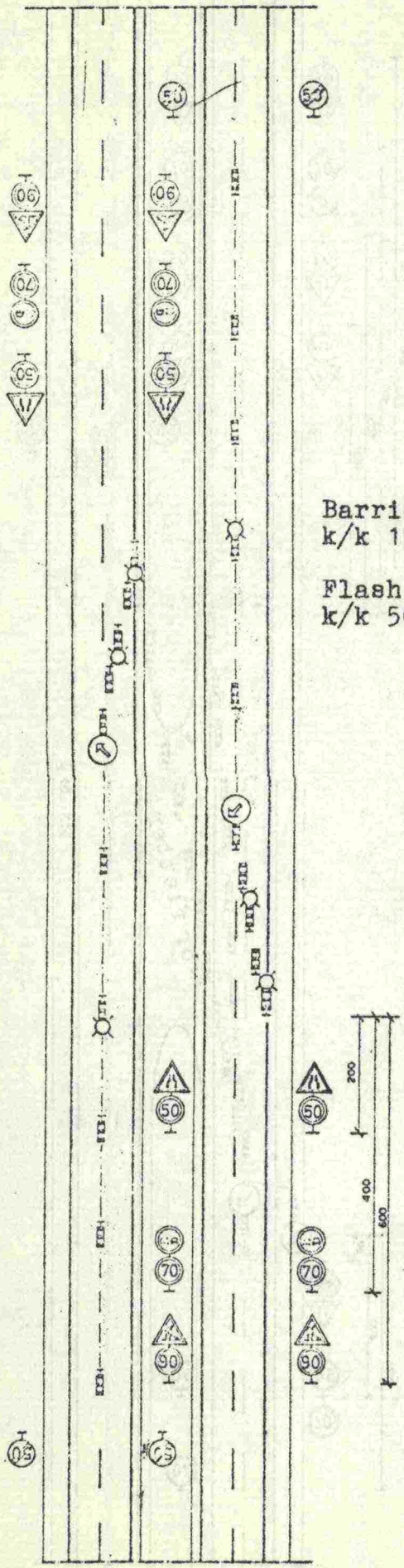


Fig.6 Single carriageway road

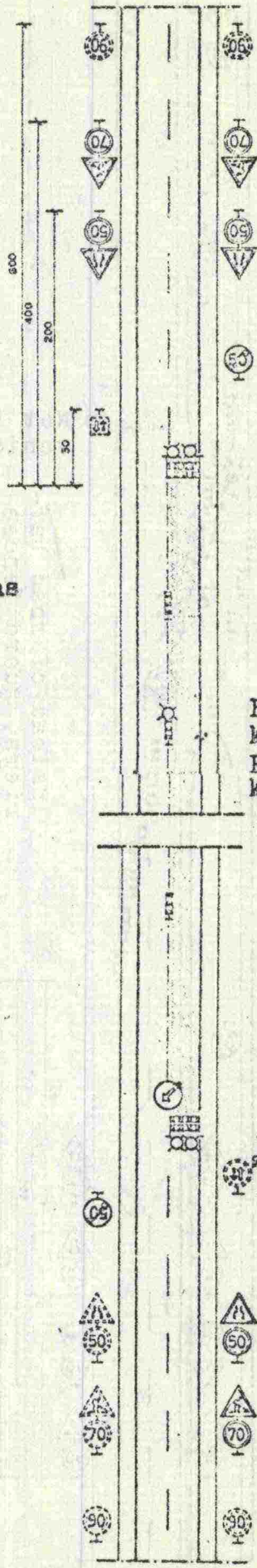
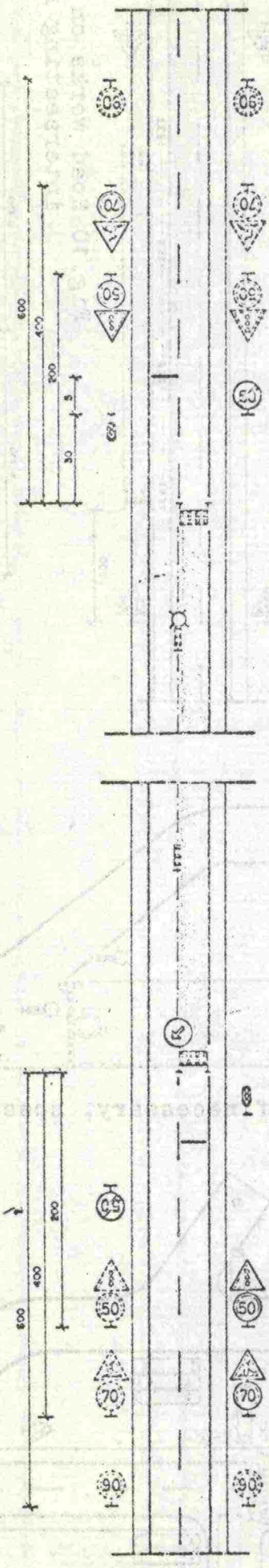


Fig.7 Single carriageway road, signal-control



Traffic signals

Stop line

In manual control, the danger sign "Road Narrows" and additional plate "Ready to stop".

Fig.8 Road with low traffic volume

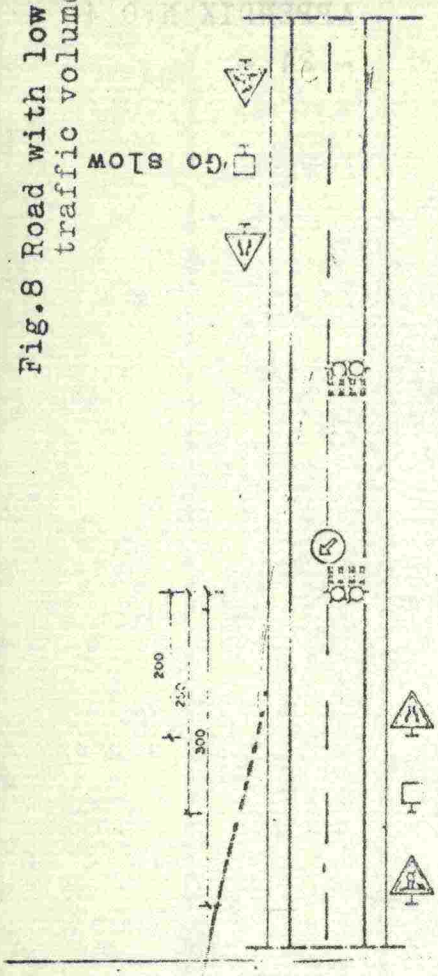


Fig.9 Road works outside carriageway

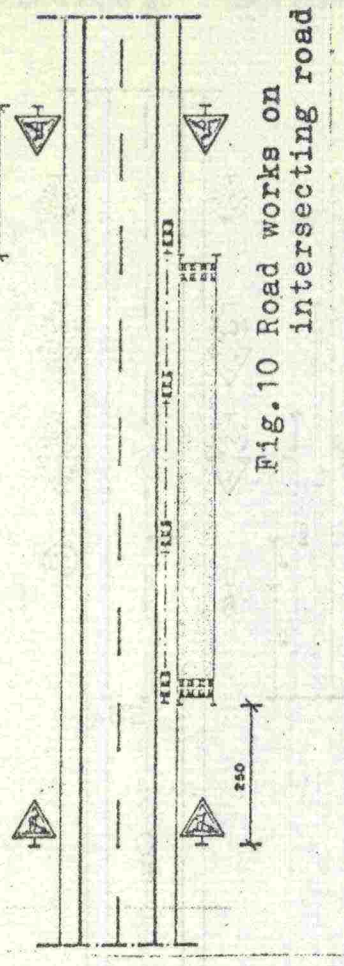


Fig.10 Road works on intersecting road

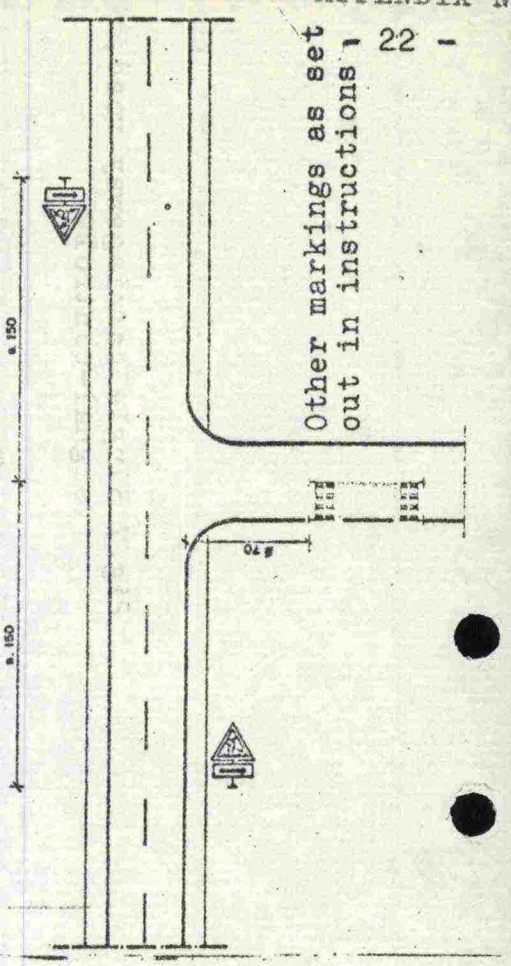


Fig.11 Short detour

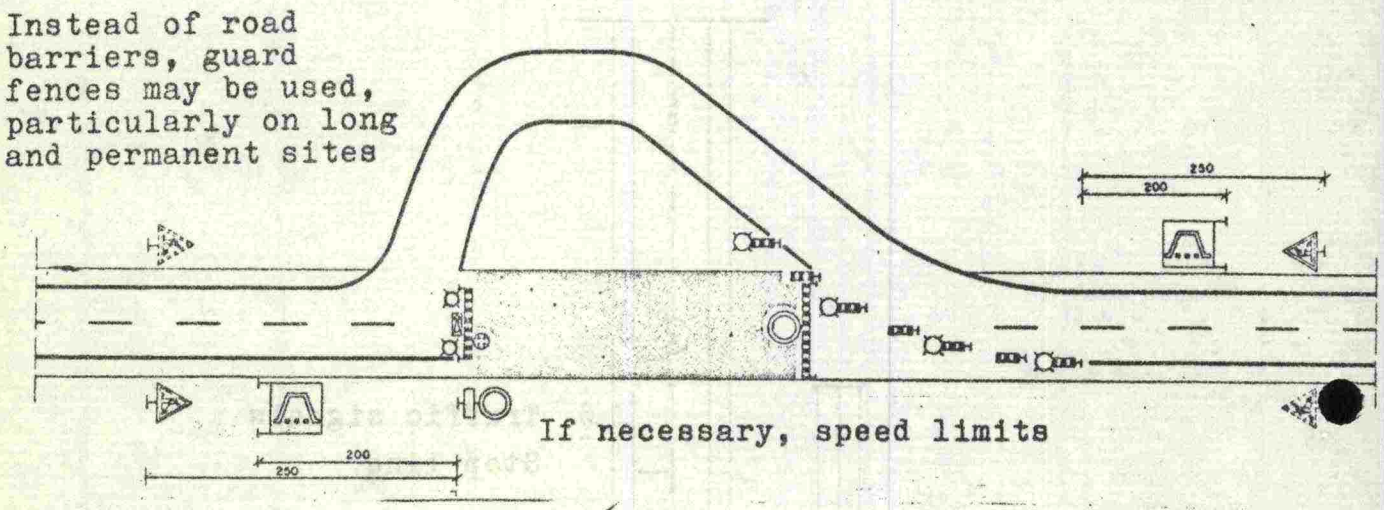
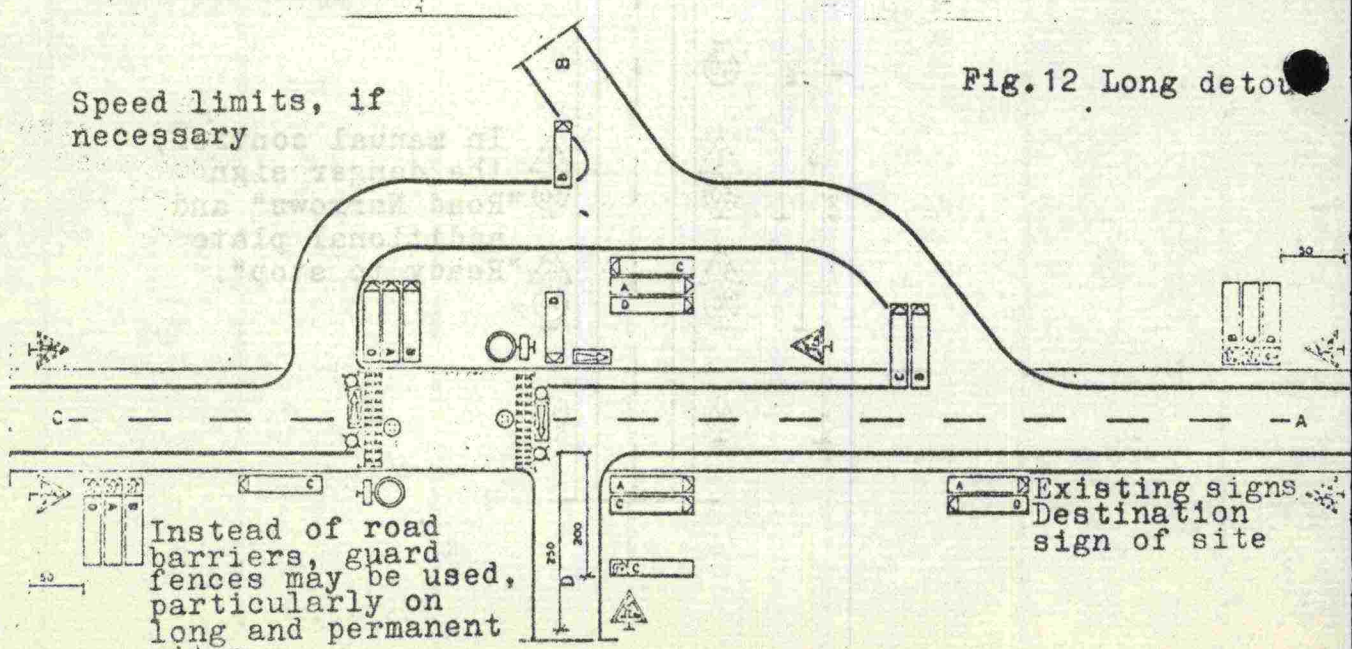


Fig.12 Long detour



SETTING-OUT AND MEASUREMENTS

General

Skilled labour and adequate equipment shall be used in measuring work. Instruments shall be inspected prior to the start of measuring work and regularly during the same.

Data needed for detailed setting-out have been given either on the Measuring Plan or additional computations shall be made by the performer of measuring work using the basic values given on the Plan.

The following terms are used of measuring work in these Specifications.

Setting-out includes both the measuring work and placing of the mark (a peg or a board etc.) at the measured spot.

The term staking is used to mean marking of the base line on the ground.

Measuring is used to determine or re-establish the location of a mark on the ground.

Traverse Stations and Bench Marks

The Contractor shall take care that the location and the level of traverse stations and bench marks are not changed during construction work. The points shall be surrounded by three clearly visible yellow timber pegs or a plank frame in such manner that they will not be damaged by accident during any stage of the work. The Contractor shall be responsible for the examination of all traverse stations and bench marks in the working area at the beginning of measuring work, after winter and if necessary even at other times to make sure that the location and the level have not changed because of frost action or some other reason.

The accuracy of new traverse stations and bench marks established during the work shall be the same as that of the original ones. The requirements for the traverse station measurements of

Class II set out in the Measuring Act (No. 91/1960) shall be applied as the accuracy requirements and tolerances to be followed. The location of traverse lines shall be determined by taking account of the use of the lines and of topographical conditions. The measurements shall be made in the same system of coordinates as traverse lines set out on the Plan. The various stages of the work are: planning, establishing points and clearing the lines, angular measurement, leveling of points, linear measurement and computations. When applicable, instructions of the establishment of traverse lines given by the Computation and Surveying Bureau of the National Board of Public Roads and Waterways (19.4.1962 and 6.3.1967) shall be followed. Furthermore, the letter No. T-2110/22.4.1968 of the Board giving instructions of the identification marks of the traverse stations established by the Board shall be followed.

M e a s u r e m e n t s

The purpose of measurements on site is to measure and set out on the ground the road or a structural part thereof in such manner that each stage of work can be carried out with sufficient accuracy.

Staking of the road to be constructed shall be in the manner required by each stage of the work and by local conditions. In this way re-establishment work and the use of extra timber can generally be avoided. The choise of the method of measurement is also affected by the classification of the road and the accuracy of construction work. The appropriate spacing in the longitudinal direction is generally 20 m, but deviations in both directions may be made depending on the stage of work and on prevailing conditions. If there is a measuring plan, it shall be followed. If one sighting board is displaced it can generally be re-erected with reference to adjacent ones, but if two adjacent boards have been displaced, they shall always be re-established by measuring. The road shall be staked on the ground in such a way that the pegs will not unduly impede construction work and that for exemple, compacting will not be hambered because of sighting boards located too close to the road.

The meaning of all pegs erected in the ground shall be distinctly indicated.

Base Line

The base line means the line in the horizontal plane staked on the ground on the basis of the measuring plan and in relation to which the structural dimensions of the road are given. The base line shall be staked on the ground either from the traverse or from tangent lines. When tangent lines are used they shall right at the beginning of the work be tied in such a way that they can always be accurately re-established. Similarly when tangent lines are used, staking shall be tied, at an interval of at least 100 m, to reference hubs placed outside the road so that staking should not be altered in connection with any remeasuring of the base line. The base line shall be staked on the ground at a spacing of 20 m unless a shorter spacing is required by conditions, i.e. in short-radius curves as at ramps. The line shall be staked on the ground with 2" x 2" timber pegs showing about 60 cm above the ground surface. The chainage shall be marked on the peg on the side towards the preceding chainage. The pegs in the base line shall, if necessary, be tied to two reference hubs placed on the same side of the road marked with the chainage and the distance from the centre line. It shall always be possible to check and re-astablish the base line on the basis of the reference hubs if required by other measurements. Tying to reference hubs shall always be carried out most carefully. The location of the principal longitudinal profile and the base line in the Typical Cross Section shall always be checked in each individual case since their location may vary.

Staking Base Line from Traverse

There are four methods that may be used as required by conditions:

- staking at right angles from the traverse
- staking at right angles from auxiliary line
- stationing on basis of point of intersection
- radial staking

S t a k i n g a t r i g h t a n g l e s f r o m t r a v e r s e. This method shall be used when the base line of the road is staked for the first time on the ground at the beginning of the work. Traverse lines are staked in accordance with staking dimensions L1 and L2. Distances S at right angles to the side are then measured from these points. If S has a negative value, the base line is to the left of the traverse line and when the distance value has no sign, the base line is to the right of the traverse line. Staking the traverse line shall be carried out accurately by using theodolites. Pegs may be made of timber 3/4" x 2", length about 1 m. The number of the traverse station (Mp), the distance from the station along the line (L), chainage of the road and the distance to the same (S) shall be marked on each peg, all this for the reason that later on, when any reference hub of the road line disappears it will not be necessary to re-establish the peg from the traverse station. Locating the peg accurately may be difficult and therefore, a power drill may be useful. At the initial stage, the field notebook shall be used to ascertain the correct station. The method is described in Appendix No. 1.

S t a k i n g a t r i g h t a n g l e s f r o m a u x i l i a r y l i n e. This method is often the most practical, quickest and accurate enough. It is used particularly in measurement at the final stage and it is almost the only method that can be used at the bottom of cuttings. Stationing shall be planned so that the end points of the line can be easily measured as for terrain conditions. The end point of the line is measured as in stationing at right angles and the dimensions are obtained from the stationing map or from the results of staking calculations. When the end points have been measured the line is to be run. Distances indicated by L1 and L2 (line staking dimensions) are measured along the line and a distance S is measured at right angles from this point. If S is negative, the base line is to the left of the line and if S has no sign, the base line is to the right of the line. An example of this method has been given on Appendix No. 2.

S t a t i o n i n g o n B a s i s o f P o i n t o f I n t e r s e c t i o n. This method is used when measuring by tape is difficult because of terrain, traffic or some other reason. A drawback in this method is the free visibility required from traverse stations to the base line. According to Appendix No. 3 theodolites are placed at stations (No. 1012 and 1013). The direction is taken from the plumb line of one theodolite to obtain the zero station. Theodolites are turned clockwise in an angle given for each stake (angle 1 or 2). The stake is taken to the point of intersection of the angles measured by theodolites. This point is the one of the base line. Should the distance or heavy traffic disturb instructions to be given to measuring staff, radiotelephones can be used.

R a d i a l S t a t i o n i n g. The angles are measured as in the method based on the point of intersection. The method deviates from the above mentioned one only in the respect that only one theodolite is needed in measuring the angle at the traverse station. The length of radius given in column R1, R2 of setting-out dimensions is measured from the vertex of the angle along the line and the base line will be reached in this manner. An example of this method has been given in Appendix No. 3.

Stationing Base Line from Tangent Line

Stationing from the tangent line shall be carried out by using the values of setting-out calculations or the curve manual. An example has been given on Appendix No. 4.

Setting-Out of Road Area for Acquisition and Preliminary Works

The area to be acquired shall be staked on the ground with timber stakes driven hard into the ground with the tops painted yellow. Markings may also be painted on rock and boulders. The appropriate spacing in populated areas and in rolling terrain is 20 m while in flat ground and in unpopulated areas a spacing of 40 m is generally sufficient. When required by conditions the spacing may have to be reduced, e.g. in densely built-up areas or if a building, tree or other feature is to be preserved.

Preliminary works such as felling of trees, clearing, removal of vegetation and stripping of topsoil shall not be carried out on the basis of stakes placed for the acquisition of the area. For each work phase, the area provided by Plan Drawings shall be staked on the ground. The areas shall be staked with 2" x 1" timber stakes left about 1 m above the ground level on which a notice such as "clearing", "stripping of topsoil" etc shall be marked by using appropriate abbreviations. At this stage any trees left in the road area, special stones or other objects to be preserved shall be specially noted. The appropriate spacing is normally 20...40 m depending on prevailing conditions.

Setting-Out for Excavation, Embankments and Foundations

For the construction of road formation the road shall be set out on the ground in such a way in regard to available machinery and to the choise of working method that the work may be carried out with sufficient accuracy. The choise of the staking method is affected by the experience of supervisory staff and machine operators, working methods of machines, terrain and by other such facts.

The sighting boards shall always indicate at least the level of the principal longitudinal profile, in which case the marking tsv shall be used. When the sighting board is above the principal longitudinal profile, the marking tsv + n x 0,5 m shall be used. If the sighting board is below the principal longitudinal profile, the marking shall be tsv - n x 0,5 m. In sighting boards established on the basis of levels of the surface of the subgrade markings ARP $\pm$ n x 0,5 m shall be used.

In earth cuttings with no rock the intersection of the ground surface and the opposite slope shall be marked with boards placed to the gradient of the slope and sighting boards are established. At this stage small stakes may also be used for marking the rounding-off of the slope.

Particularly in deep earth cuttings with rock the marks for excavation should be placed only when the rock surface has been uncovered to some extent. The rock surface may deviate from that shown on the surveys and the depth of the cutting will change.

The appropriate spacing is 20 m. Shallow cuttings may be marked by means of sighting boards placed at right angles to the base line outside the road area (Appendix No. 5). The nearest sighting board shall be placed at a distance of n x 1 m from the base line and the distance shall be marked down in the sighting board. The outer sighting board shall be placed at a distance of 5...20 m from the inner one depending on terrain conditions. The horizontals indicating the height shall be fixed to the gradient of the wider excavation side at a proper height of n x 0,5 m from the level of the subgrade or the principal longitudinal profile. At this stage it shall be specially noted that the horizontals are parallel to the excavation surface and not the final surface of the road since these surfaces are not normally at the same gradient. Changes of grandient of the excavation surface shall be marked with stakes in course of excavation work. Side ditches at the bottom of the cut shall be marked by means of sighting boards placed in the ditch line.

If sighting boards placed at the bottom of the cut do not impede excavation work the method shown on Appendix No. 6 may be employed. The intersection of the slope and the ground shall be marked as described above. Sighting boards shall be placed at the changes of gradient of the excavation surface at a height of 1 m from the surface in such a way that each point may be sighted by means of a traveller.

In rock excavation sections the spacing of sighting boards shall be reduced in order to obtain sufficient accuracy and certainty and to facilitate the work of drill operators. Sighting boards parallel to the surface of excavation shall be placed in the cutting in transverse direction. The height of the boards shall be equal to the depth of excavation added with n x 0,5 m.

Cuttings differing from the normal construction of the road such as difficult transition wedges and cuttings made for landscaping purposes shall be marked out as required by circumstances in accordance with the construction plan.

Staking required by embankment construction shall be carried out

in such a way that the embankment can be constructed to correct level and shape without undue obstruction to construction and compaction.

Sighting boards shall be placed i.e. as set out on Appendix No. 7 in such a way that one permanent-size traveller may be used in the construction of formation when the road is sloping to one side. In roads with a camber two horizontals shall be used in the traveller of which one is to be used at the camber and one at the edge of the roadway, or both sighting boards shall be placed on the both sides of the road.

Another method has been shown in Appendix No. 8. The marking method shown in the Figure can be used, for example, in the construction of the embankment by end-tipping method. In that case sighting boards shall be placed in front of and behind the fill front in the longitudinal direction of the road. The method can also be used in other embankment construction works.

In placing of sighting boards for foundation works the methods specified in connection with excavation and embankment construction shall be applied. Since the original soil in foundation works is often displaced even outside the road and embankments often settle, setting-out may frequently have to be renewed. Sighting boards should, if necessary, be placed on firm ground.

Setting-Out for Drainage and Sewerage Work

Prior to the start of excavation for drainage and sewerage the ditch and the pipelines shall be set out by using the spacing specified on the Drawings. On account of any disappearance of pegs during the work the vertices of the base line or other pegs needed for re-establishing shall be provided with reference hubs placed outside the working area. The points of trenches where the gradient or the direction is altered shall be marked with sighting boards placed at right angles to the trench for determining the excavation depth specified on the Plans. Sighting boards shall always be used in sewer and underdrain ditches. The height of boards shall be chosen on the basis of the depth of excavation of the sewer, underdrain or ditch so

that the length of the traveller is of even 50 cm-lengths. In order to facilitate installation of pipes, sighting boards shall be used at a spacing of 15...30 m. A cord placed between sufficiently firm sighting boards in the middle of the pipeline can also be used during installation, The location of culverts shall also be set out and provided with necessary sighting boards and in special cases with excavation models, when a trench specified on the Plan is excavated.

The plans shall be set out on the ground by applying the requirements for accuracy specified hereinafter.

Setting-Out for Construction of Road Pavement

For the construction of road pavement the final surface of the road shall be set out on the ground. Sighting boards shall be placed so that they do not impede compacting and shaping of the surface. Sighting boards shall be placed outside the road pavement and the horizontals according to the road surface at a height of 1,0 m above the surface (Appendix No. 9). If the combined thickness of layers exceeds 0,7 m the height of boards from the road surface shall be 0,50 m since sighting may otherwise be difficult when lower layers are constructed. Travellers of different length shall be used for the construction of each individual layer.

The base line shall be inspected before placing of sighting boards. Markings shall be made with utmost care since the final road surface will be shaped as indicated by these sighting boards.

Setting-Out for Slopes

Slopes shall be marked on the ground in such a way that they can be constructed with such an accuracy that no unsightly irregularities will be visible. At low slopes the sighting board may be placed on the level of the slope. This method, however, is not suitable on high slopes since placing of boards requires a lot of work and they are easily displaced. In construction of embankment slopes marking of the top and the toe of the slope is generally sufficient.

Some methods for the setting-out of slopes have been shown on Appendix No. 10. When the slope is being trimmed for landscaping sighting boards may be placed in a grid of 10...20 m. The heights are generally obtained from a grading plan and its countour lines. This method may also be used in other slopes.

Setting-Out for Crossings, Guardrails and Carriageway Markings

Crossing shall be set out on the ground according to Drawings by means of staking computations for the road channels in which case the necessary heights are obtained directly from the drawings of the crossing or from the longitudinal sections of the channels.

Another method is to calculate the location and level of all points by using the reference points within the area of the crossing. The accuracy and the spacing of setting-out depend on the stage of work. Final channels, islands and the level of the crossing shall be set out with special care.

Guardrails shall be set out very accurately since errors made are easily seen. A separate grade line shall be planned for all rails requiring a particularly good finish such as bridge rails and steel rails. The channel levels of the road cannot always be used as such for reference purposes since unsightly bends may exist because of camber. In order to determine the height of rails the channel levels shall be drawn on squared paper to a scale of 1:1000/1:10 and the line obtained is adjusted with a curve. The level of the rail at each post may be read from this drawing.

Carriageway markings shall be set out with special care since they will give the driver the impression of the final shape of the road. Markings shall be painted on the surface.

Setting-Out for Bridges

Bridges shall be set out on the ground by means of dimensions given on the Drawings. The base line and other auxiliary lines used in setting-out for bridges shall be tied in such a way that they can be accurately re-established during all stages of the work. The level of the bridge shall never be determined on the basis of one bench mark: at least two bench marks of

the road plan shall be used, with the exception of bridges planned separately and for which only one bench mark is available. One method of setting out bridges has been given in Appendix No.11.

In setting-out for intersection bridges the measurements shall be checked on the basis of the measuring plans of both roads.

A c c u r a c y o f S e t t i n g - O u t

The accuracy referred to in the heading means the setting-out in accordance with Working Drawings of the various parts of the work within a certain range of accuracy both in the horizontal (x-y) and in the vertical direction (h).

The accuracy requirements for site measurements for the construction of road pavement are as follows:

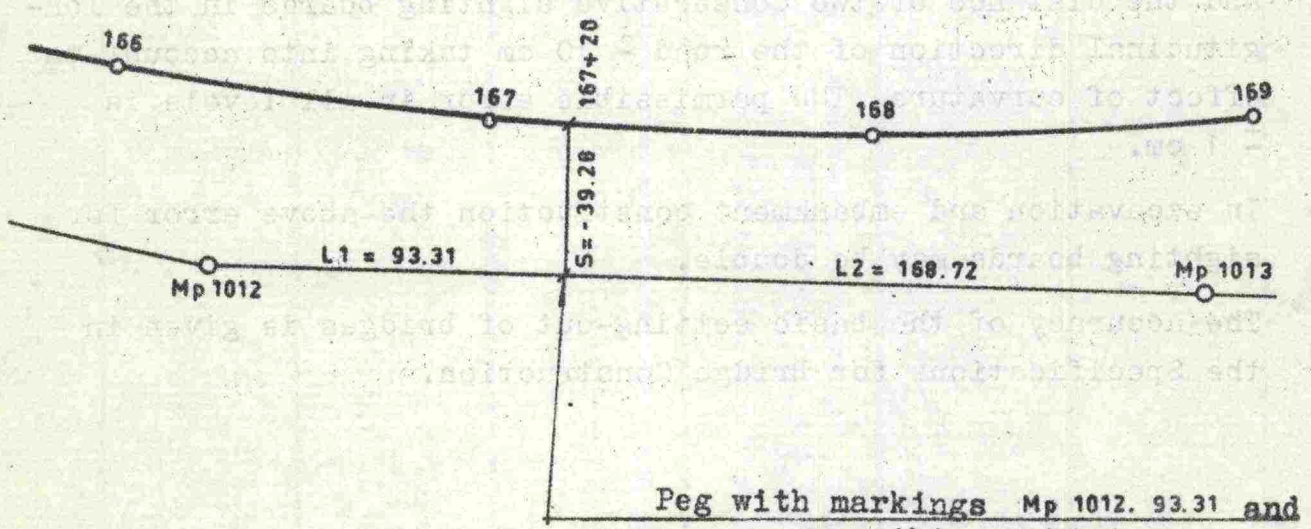
The permissible deviation in the base line measured twice from the traverse is $\pm$ 3 cm. The permissible deviation between two adjacent pegs in the line is $\pm$ 5 cm. The lateral error in the base line when consecutive pegs are compared shall not exceed $\pm$ 3 cm, the distance of sighting boards from the base line $\pm$ 1 cm and the distance of two consecutive sighting boards in the longitudinal direction of the road $\pm$ 10 cm taking into account the effect of curvature. The permissible error in all levels is $\pm$ 1 cm.

In excavation and embankment construction the above error for sighting boards may be double.

The accuracy of the basic setting-out of bridges is given in the Specifications for Bridge Construction.

SETTING-OUT AT RIGHT ANGLES FROM TRAVERSE

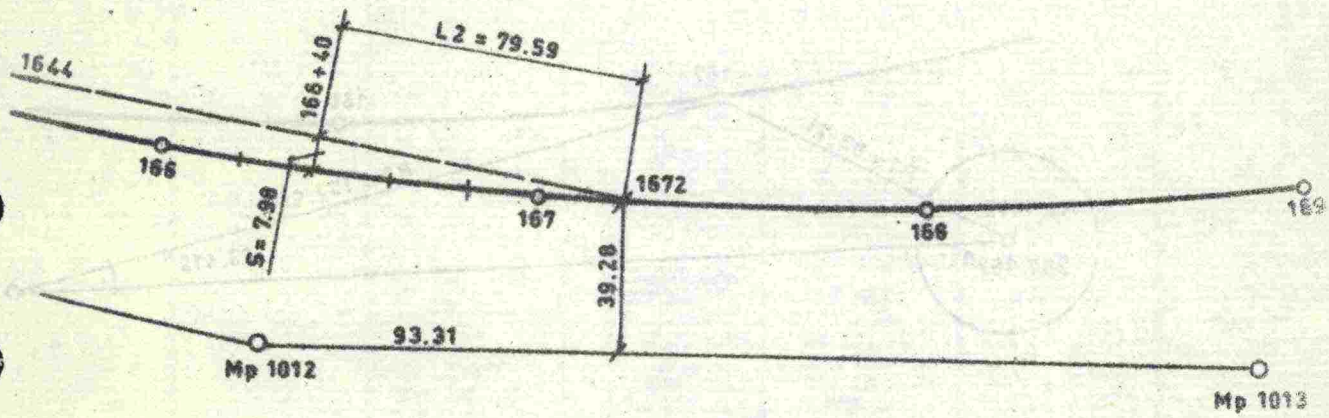
Chainage	N:O Traverse	L1 / L2	s	Radius 1 / Radius 2	Angle 1 / Angle 2	X / Y
16680.00 M	1012	53.39	- 41.87	67.85	357.660	684792.50
0.00 M	1013	208.64		212.80	12.609	525296.71
16700.00 M	1012	73.34	- 40.37	83.71	367.962	684778.47
0.00 M	1013	188.69		192.96	13.419	525310.97
16720.00 M	1012	93.31	- 39.28	101.23	374.636	684764.73
0.00 M	1013	168.72		173.23	14.560	525325.50



Peg with markings Mp 1012. 93.31 and pl. 167+20. - 39.28 this marking on the side of M_p 1013

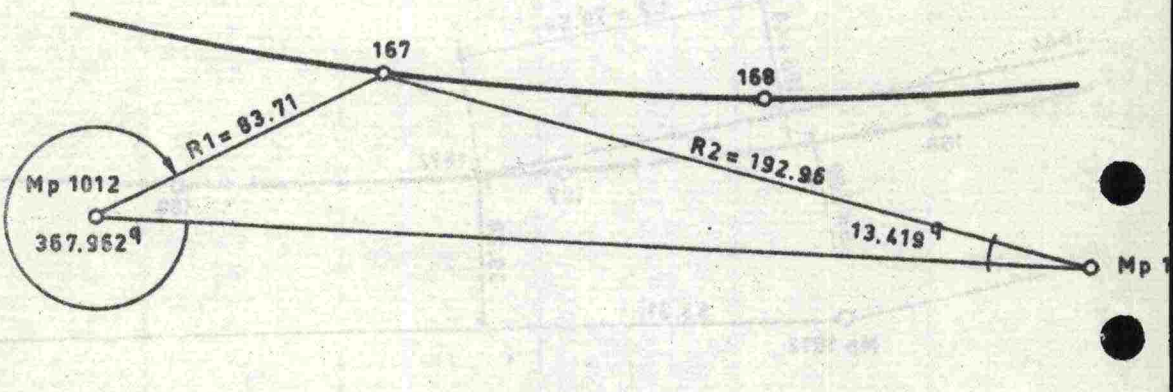
SETTING-OUT AT RIGHT ANGLES FROM AUXLIARY LINE

Chainage N:O	Traverse or aux.line	L 1 L 2	S	Radius 1 Radius 2	Angle 1 Angle 2	X Y
16640.00 P	1644	199.51	7.98	199.67	2.545	684821.41
0.00 P	1672	79.59		79.98	393.637	525269.06
16660.00 P	1644	219.46	6.58	219.56	1.909	684806.82
0.00 P	1672	59.63		60.00	393.000	525282.74
16680.00 P	1644	239.38	4.79	239.43	1.273	684792.50
0.00 P	1672	39.72		40.00	392.363	525296.71
16700.00 P	1644	259.26	2.59	259.28	0.636	684778.47
0.00 P	1672	19.84		20.00	391.728	525310.97
16720.00 P	1644	279.10	0.00	279.10	400.000	684764.73
0.00 P	1672	0.00		0.00	13.984	525325.30

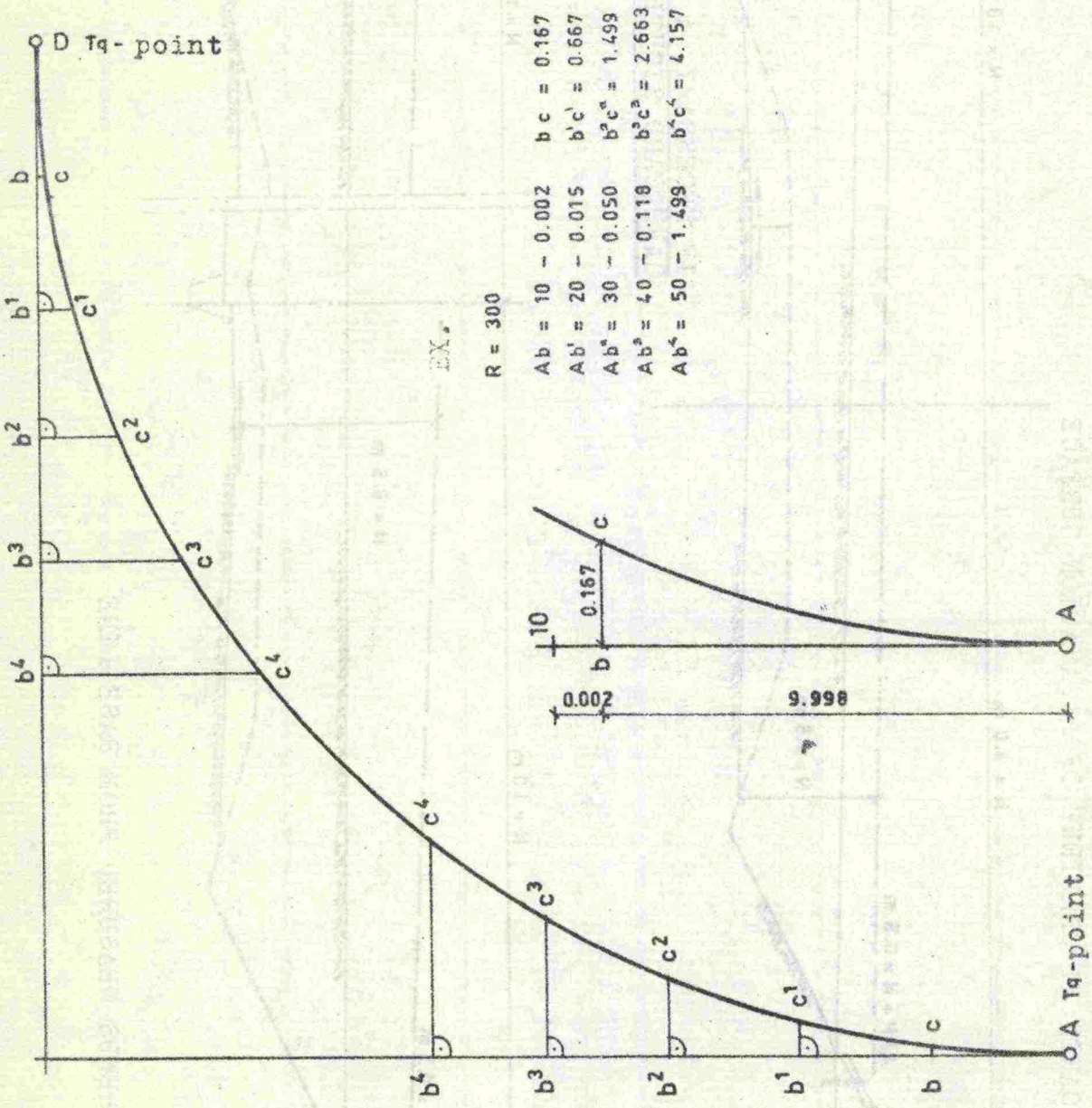


SETTING -OUT ON BASIS OF POINT OF INTERSECTION AND RADIAL SETTING-OUT

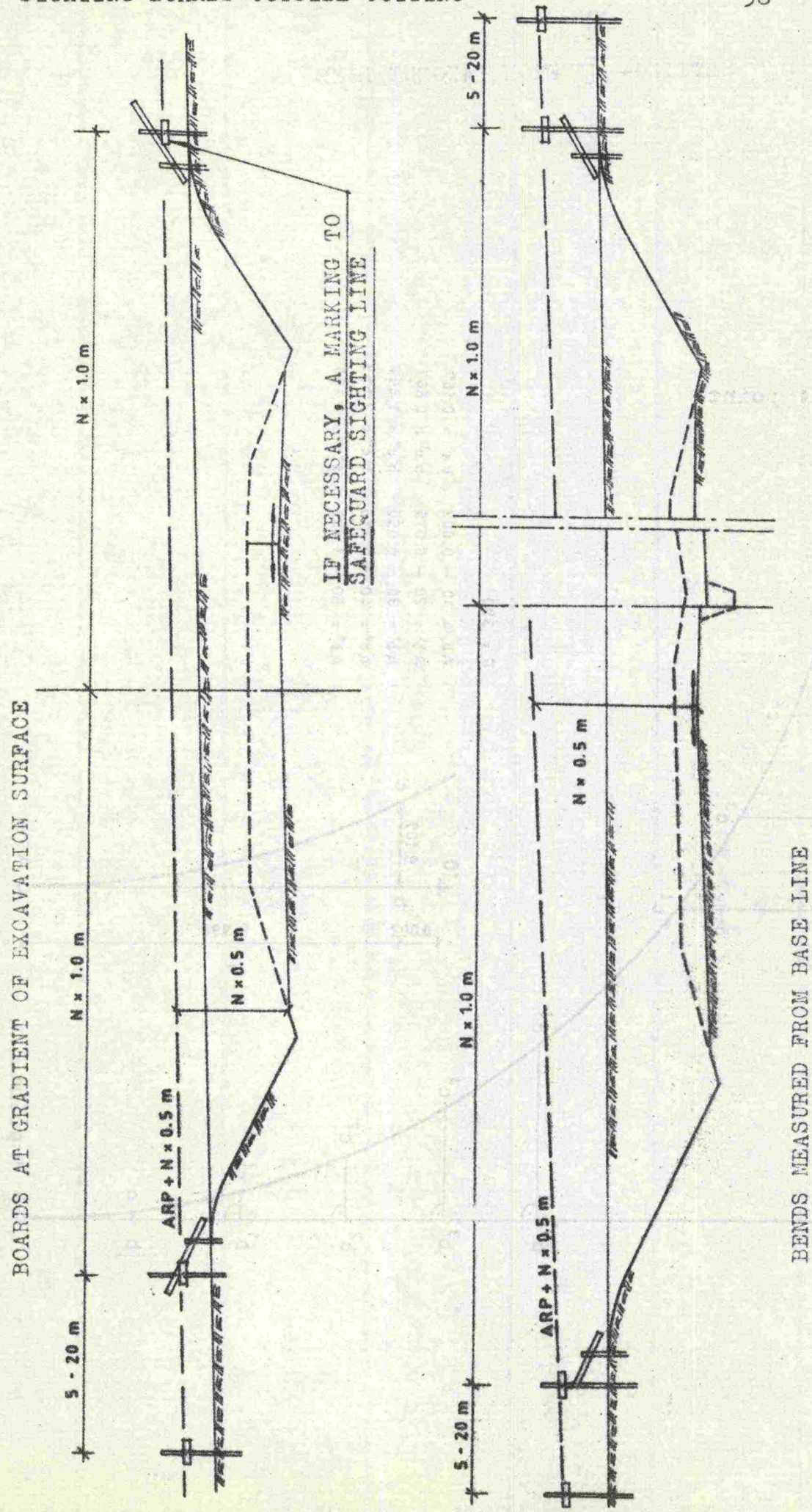
Chainage N:o	Traverse	L 1 L 2	s	Radius 1 Radius 2	Angle 1 Angle 2	X Y
16640.00 M	1012	13.61	- 46.07	48.04	318.293	684821.41
0.00 M	1013	248.41		252.65	11.673	525269.06
16660.00 M	1012	33.48	- 43.77	55.11	341.570	684806.82
0.00 M	1013	228.54		232.70	12.047	525282.74
16680.00 M	1012	53.39	- 41.87	67.85	357.660	684792.50
0.00 M	1013	208.64		212.80	12.609	525296.71
16700.00 M	1012	73.34	- 40.37	83.71	367.962	684778.47
0.00 M	1013	188.69		192.96	13.419	525310.97
16720.00 M	1012	93.31	- 39.28	101.23	374.639	684764.73
0.00 M	1013	168.72		173.23	14.560	525325.50
16740.00 M	1012	113.29	- 38.58	119.68	379.107	684751.28
0.00 M	1013	148.73		153.65	16.156	525340.30

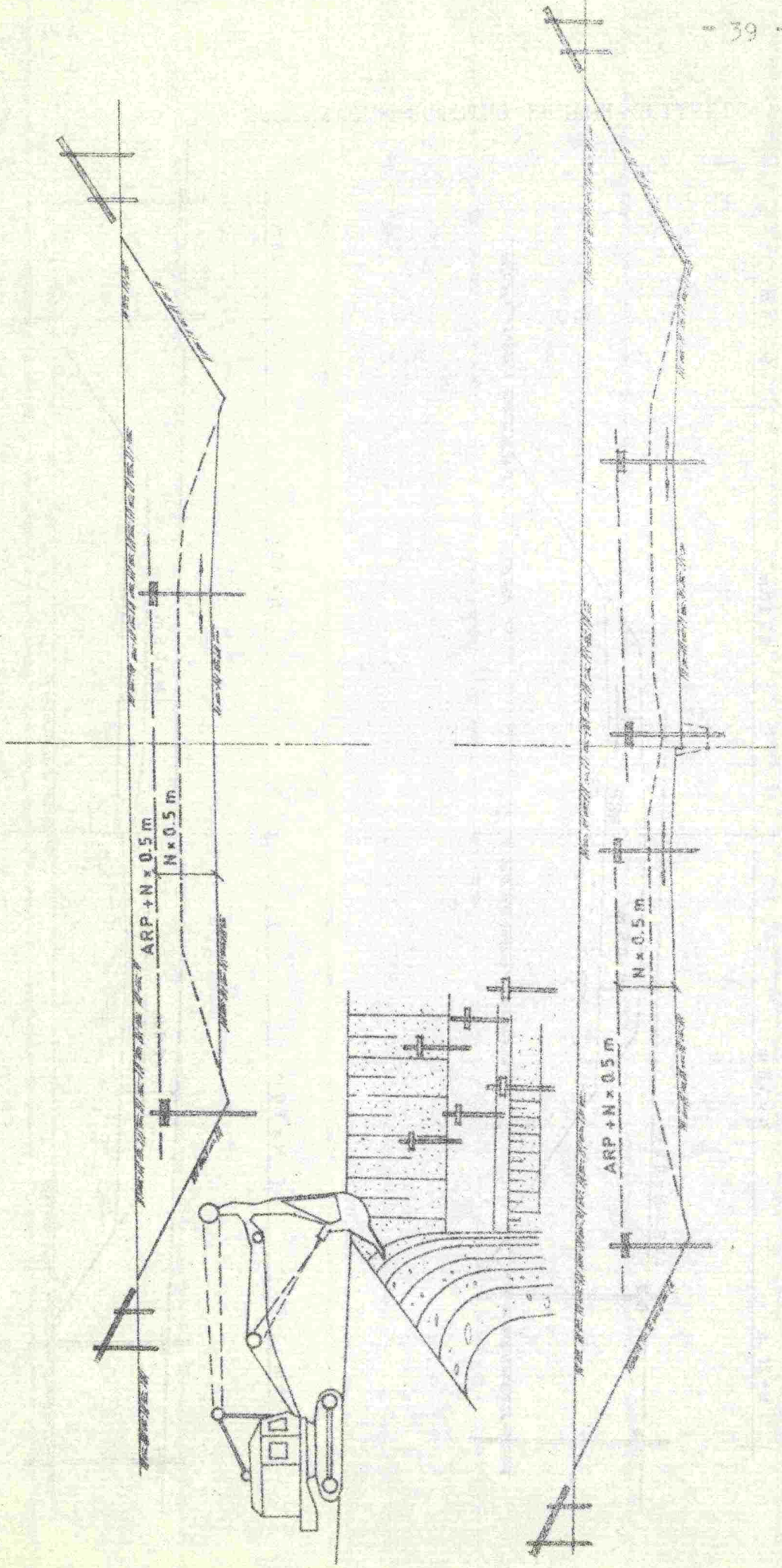


SETTING-OUT FROM TANGENT LINE

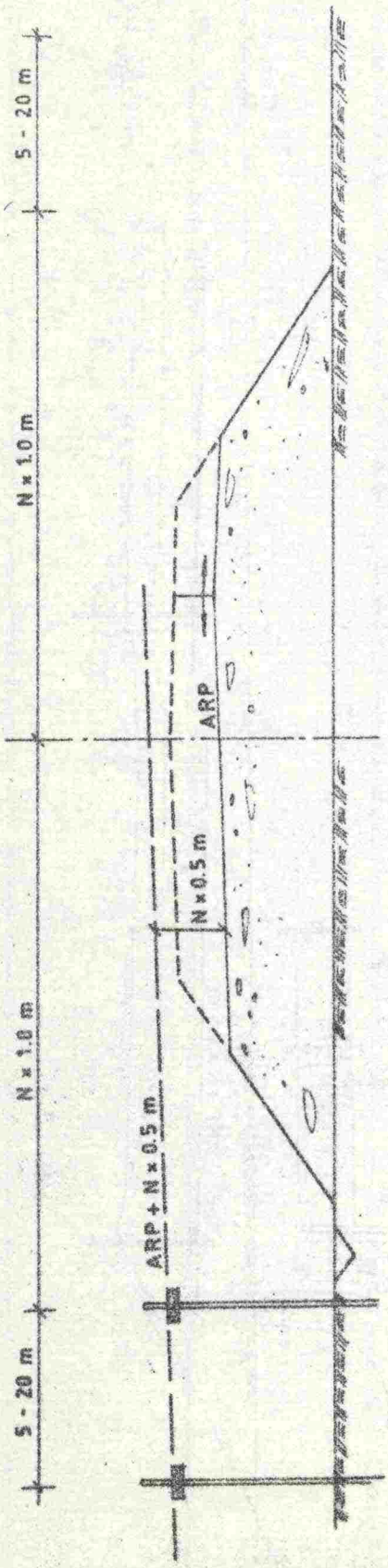


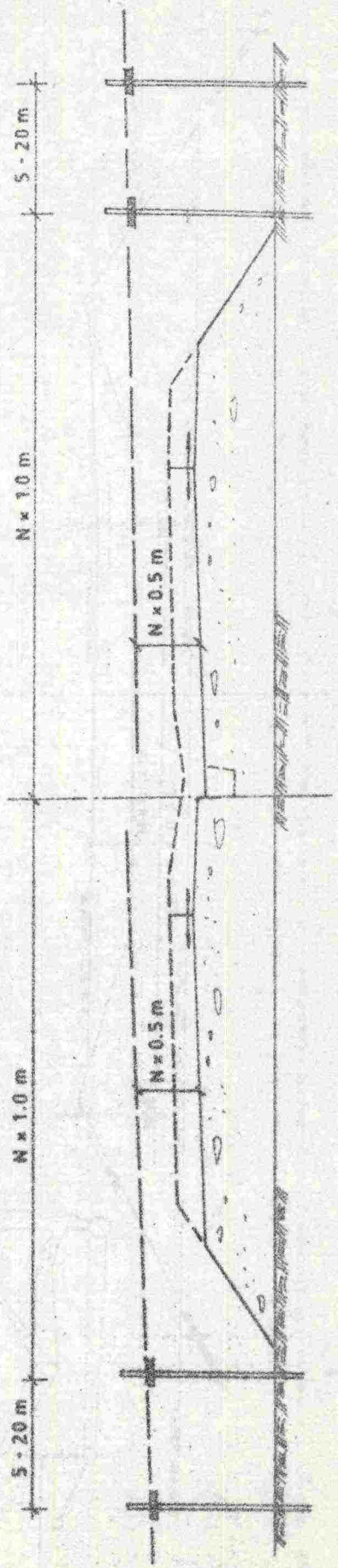
SIGHTING BOARDS OUTSIDE CUTTING




ARP +N x 0.5 m
N x 0.5 m
N x 0.5 m
ARP +N x 0.5 m

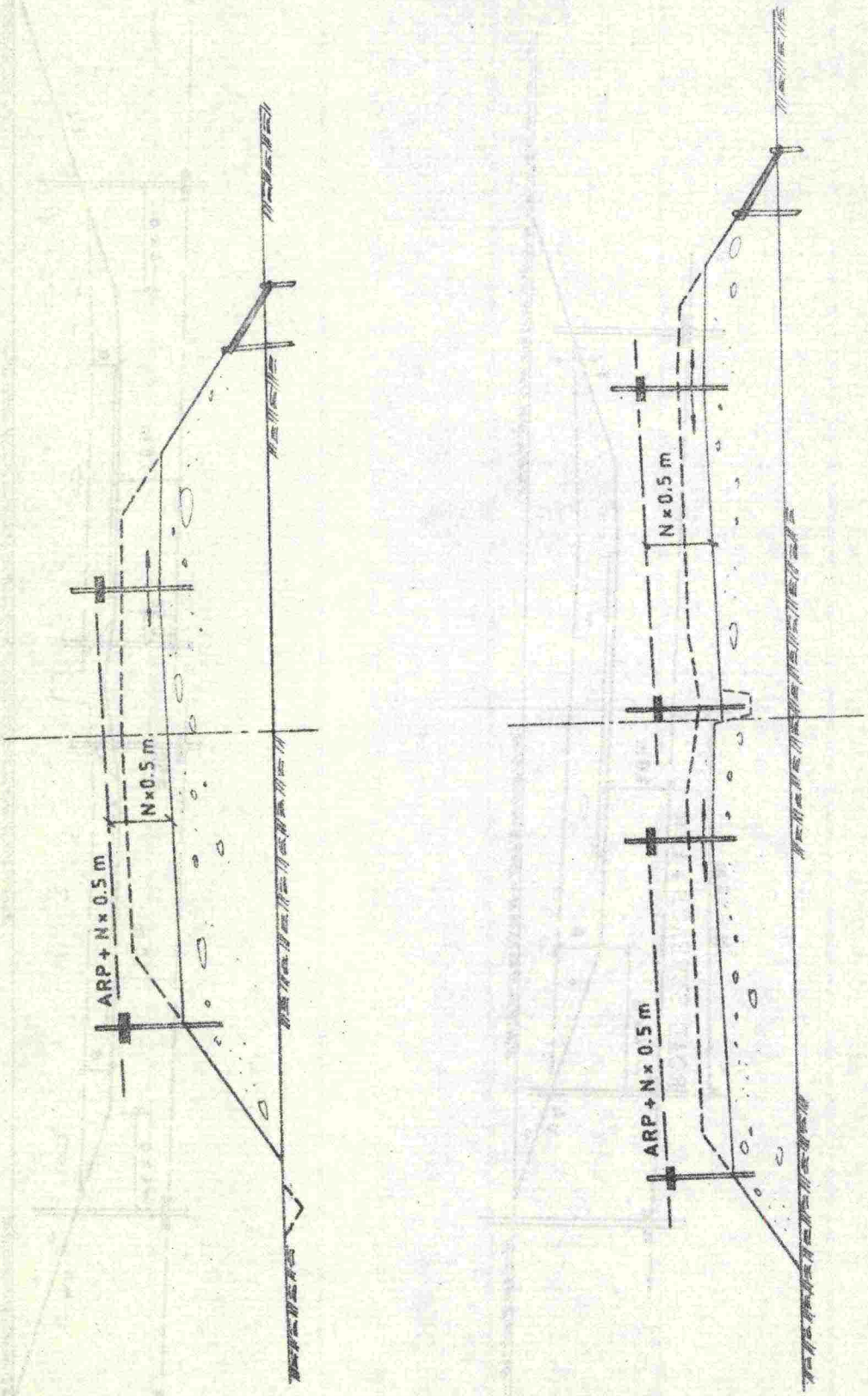
SIGHTING BOARDS OUTSIDE EMBANKMENT

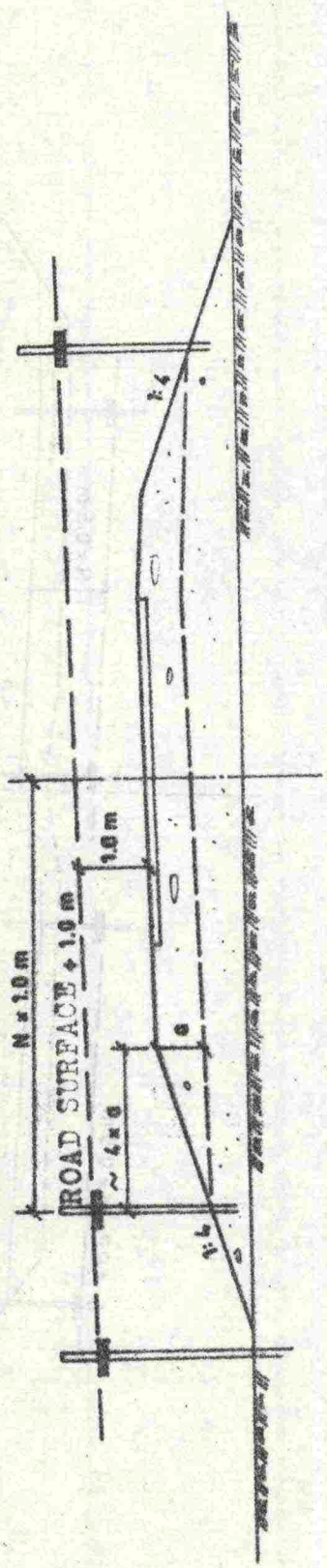


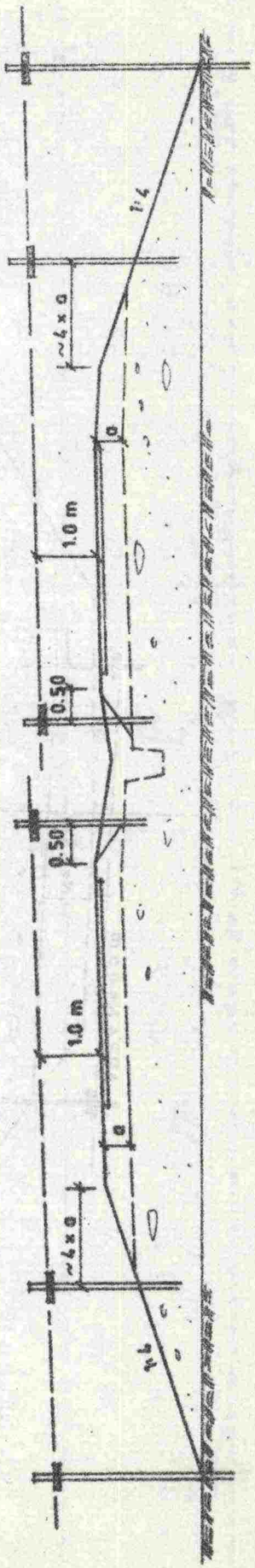


BOARDS AT GRADIENT OF EMBANKMENT SURFACE

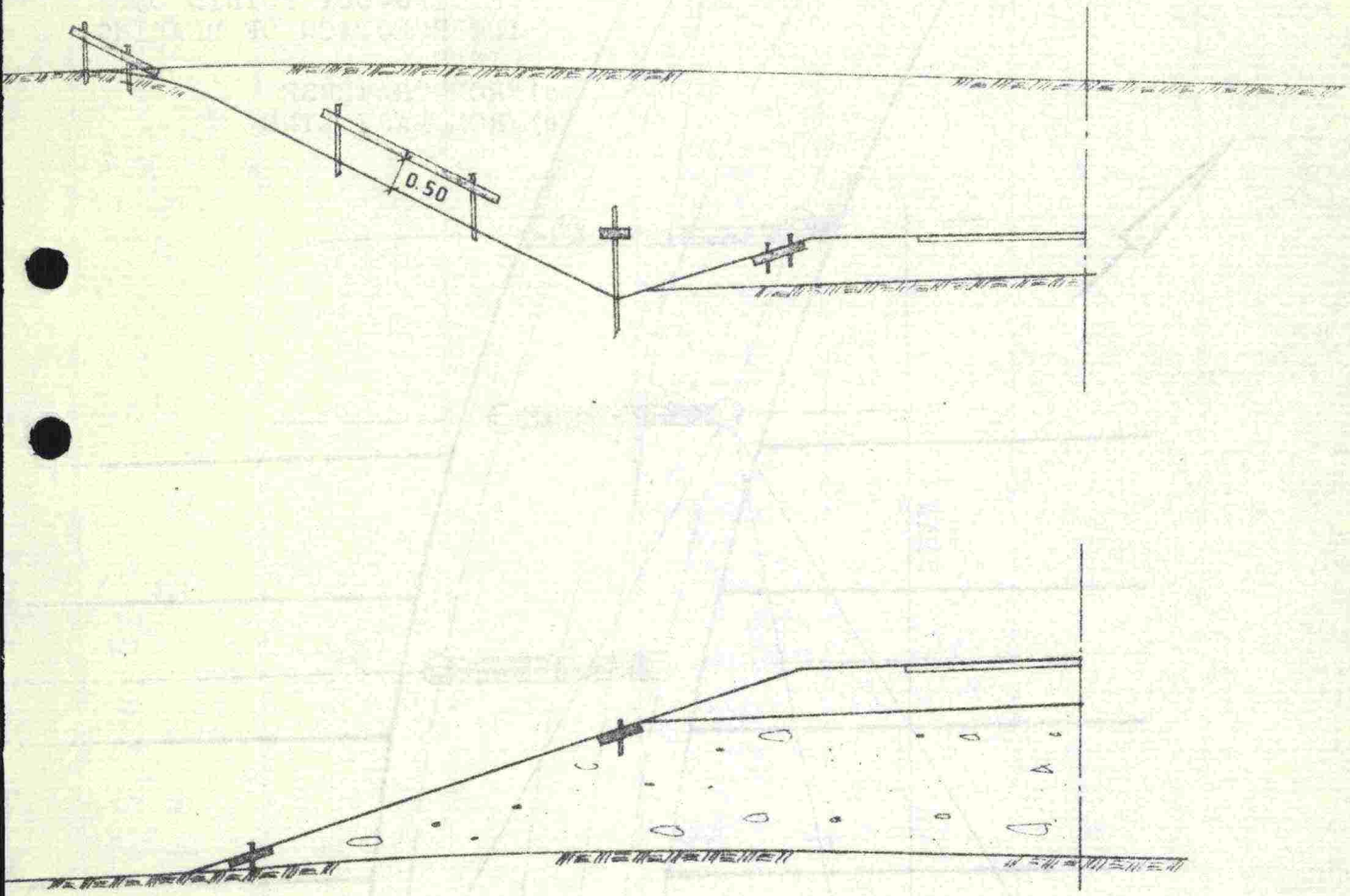
SIGHTING BOARDS ON EMBANKMENT



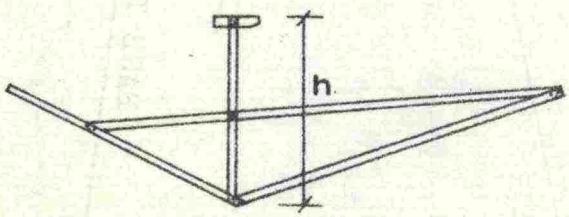

N x 1.0 m
ROAD SURFACE + 1.0 m
1.0 m
~4 x a
a
1:4


1:4
~4 x a
a
1.0 m
0.50
0.50
1.0 m
a
~4 x a
1:4

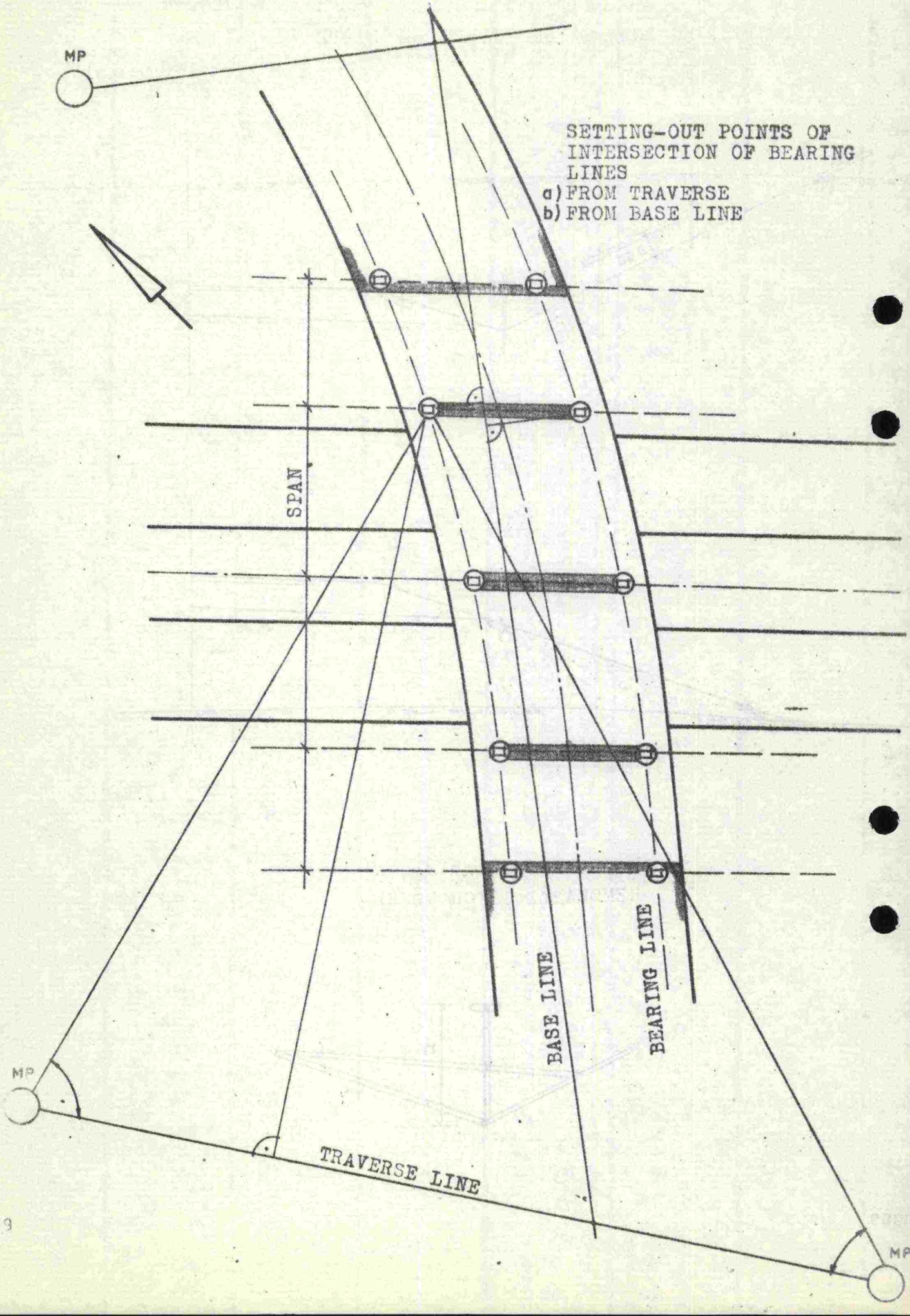
SIGHTING BOARDS FOR SHAPING OF SLOPES



REMOVABLE DITCH MODEL



EXAMPLE FOR SETTING-OUT OF BRIDGE



BORROW PITS AND TIPS

Borrow pits and tips should be reserved on the basis of procedures specified in the Road Act in connection with the meeting of acquisition. If this has not been done written agreement on the use of borrow pits and tips shall be made with landowners prior to the use of such areas. In addition to economic questions such agreements shall clarify the obligation to reinstate and finish borrow pits and tips and the obligation to construct and maintain any safety fences.

Landscaping and nature preservation factors shall be borne in mind when borrow pits and tips are selected for use. Should the use of a known material deposit have an injurious effect on surrounding landscape, the material should be acquired from other sources. If this is not possible, the workings should be hidden from the view as much as possible by opening the pit from a suitable side or by erecting a screen. Areas used shall be tidied up to such an extent that no impurities will get mixed with construction materials. Areas shall be used and screening and other refuse shall be stored in such manner that the use of the deposit later on is not impeded.

Tests of the quality of materials before and during the work are specified in Item "Classification of Soils and Testing" of these Specifications.

M a t e r i a l D e p o s i t s

When material sources are exploited great care shall be taken to ensure that there is no risk of pollution of groundwater intended for water supply and that the water table is not lowered to such extent that has a detrimantal effect on other structures and the use of ground water. Steps shall also be taken to ensure that the ground is not contaminated by storing fuel oils, dust abatement agents or bituminous binders etc. In case of doubt the authorities should be consulted.

Rock areas shall be chosen so that noise and dust of quarrying and crushing will not unduly disturb the neighbourhood. When

quarrying has been finished special attention shall be given to the erection of safety fences and to other safety measures.

T i p s

Excess materials may, as directed by the Employer, be used in constructing stockpile areas, flattening of embankment slopes or landscaping in the vicinity of the road. If a separate tip is taken into use outside the road area, landscaping factors shall be taken into consideration. The aim should be to use excess materials in filling abandoned gravel pits, clay sources, unsightly hollows, open quarries etc. When choosing tips the bearing capacity of the ground and the risk of pollution of ground water shall be borne in mind. Stumps and other refuse may, with the permission of the landowner, be used for filling unsightly hollows by the road. In that case an approximately 30 cm thick filling layer shall be placed on the area by using vegetation or other waste material removed from the road area. In stockpiling measures shall be taken to prevent flowing by using edge walls made of drier earth and/or the surface shall be protected, where necessary, because of the risk of erosion.

R e i n s t a t e m e n t

Prior to the use of borrow pits or tips a plan shall be prepared for landscaping measures required. As soon as borrow pits or tips have been taken out of use slopes shall be trimmed and top edges rounded off. Excavated surfaces shall if necessary be grassed and planted and safety devices such as fences shall be erected. Tips shall also be tidied up and shaped in such a way that they do not differ from the surrounding terrain.

CLASSIFICATION OF SOILS AND TESTING

C l a s s i f i c a t i o n o f S o i l s

Determining the correct and most advantageous purpose and method of use of soils needed in road construction calls for continuous classification of soils on the part of the constructor.

The suitability for intended use of all materials taken both from the road area and from borrow pits shall be systematically investigated. In addition to the bottoms of cuttings the subsoil shall also be investigated under low embankments in cases when the subsoil can be anticipated to be decisive in the determination of the thickness of the road pavement.

In classification of soils either the soil type or the soil type and the bearing category jointly shall be determined depending on the intended use of materials.

Technical Classification

In connection with technical classification of soils the principles, definitions, abbreviations, symbols and testing methods specified in Item 22 of the Standard Specifications for Foundation Work 1964 of RIL and in Appendixes II and III thereto shall be followed as far as they are not differing from the specifications given by the National Board of Public Roads and Waterways.

Determination of Frost-Susceptibility

The frost-susceptibility of soils shall be determined by using the grading curves obtained in connection with technical classification by comparing them with the Form for Determination of Frost-Susceptibility of Soils (Appendix No. 1) (TVH 2.545). In addition to determination based on grading curves the capillary rise shall also be determined in laboratory in such borderline cases where the soil may be frost-susceptible because of local conditions although appearing to be frost-resistant on the basis of grading. The capillary rise shall therefore in most cases be determined for fine-grained soils within the boundary zone. Determined by this method soils are considered frost-susceptible when the capillary rise of water is $\geq$ 1,0 m.

Classification of Bearing Capacity

In order to determine the road pavement layers the bearing capacity of either the subsoil or of embankment materials shall be determined depending on each case.

Soil types are divided into bearing categories as to their bearing capacity as indicated on Appendix No 2 (TVH 2.546).

Actual classification of bearing capacity shall be effected by comparing grading curves obtained in technical classification and the results of the determination of frost-susceptibility with the Bearing Classification Form (Appendix No. 2) and with the tables of pavement design (Appendixes 1600/1...9).

T e s t i n g

The basic principle to be followed in supervision of road construction work shall be that the Constructor shall always be able to prove that the material used and the final result conform to requirements specified on Documents.

During the work all tests specified on Specifications and Instructions shall be carried out and all required certificates obtained. Testing of materials and workmanship listed below shall be also taken. If the number of samples to be taken has been specified, it shall be taken as a minimum sufficient provided that workmanship is of high standard and the resulting work of a uniform quality.

The current publication of the quality control of surfacing works of the National Board of Public Roads and Waterways (TVH 2.813), the Publication of the quality control of crushing works of the Board (TVH 2.814) and, when applicable, the instructions for the quality control of subgrade and unbound layers of the road pavement (TVH 2.816) shall be followed in road construction work.

The appropriate forms given in the current List of Publications of the National Board of Public Roads and Waterways (TVH No. 6.151) or appropriate forms of the State Institute for Technical Research shall generally be used in the quality control of construction work.

Inspecting Measuring Equipment

Prior to the start of measuring work the Contractor shall inspect the equipment used and the inspection records shall be filled. Levelling equipment shall be inspected at least once a

month and theodolites at least every fourth month. Measuring tapes used in precision measurements on the site shall also be inspected. All weighing machines shall be inspected as directed by the manufacturer. Even other measuring equipment not mentioned herein shall be inspected frequently enough.

Testing of Materials

Soil classification of the subsoil shall be carried out if of decisive importance in pavement design.

Excavated or borrow materials to be used in embankment fill shall always be classified prior to their use and during the work when the suitability of the material to intended purpose may be doubted.

The suitability of natural materials to be used in the road pavement or in special structures shall always be proved by gradation tests prior to the work and during the work by at least one sieving for each 500 m^3 undisturbed quantity to be used for each purpose or already dumped onto structures concerned. If it can be assumed that the material is not conforming to the quality requirements, check tests shall furthermore be made before the material is rejected.

For non-standard pipes and other material used in road construction work the manufacturer's certificates shall be obtained in which at least the data referred to in the Specifications for similar materials shall be given.

Testing of Density

The density of structures shall be systematically determined in all locations where a density requirement has been specified.

The maximum dry density of earth embankments and road pavement layers shall be determined for each different material, in Road Pavement Categories 1, 2, 3 and 4 for each new undisturbed quantity of 3000 m^3, and in Road Pavement Categories 5 and 6 from the surface of the subgrade for each section of 500 m. In Road Pavement Categories 7 and 8 no determination of dry density and density is generally carried out. In Road Pavement

Categories 1, 2, 3 and 4 the dry density and the degree of compaction shall be determined for each layer to be compacted at one time from each lane at an average interval of 100 m and from the section formed by the shoulder and the slope and from any central reserve at an interval not exceeding 200 m. In Road Pavement Categories 5 and 6 the respective maximum intervals shall be 150 m and 300 m. In macadam or stone layers no determinations of density are carried out.

The determination of the maximum dry density (improved Proctor Method), the field determination of dry density, moisture content and the performance of the plate loading test have been shown on Appendixes Nos. 1, 2, 3 and 10 of the Publication No. 2.816 of the National Board of Public Roads and Waterways.

In connection with special structures the degree of compaction of earth materials shall be tested by determining the maximum dry density of all different materials used in backfilling and foundations.

The dry density and the degree of compaction shall be determined for each part of each separate structure. At least two samples shall be taken from each layer.

In pipeline trenches account shall furthermore be taken of the fact that the above sample pairs only represent a section of 100 m.

The grading of the sample shall always be tested in connection with the determination of the maximum dry density. The grading indicates when the material has changed in such extent that a new maximum dry density shall be determined.

The location of the sample shall be fixed by indicating the chainage, the distance from the centre line and the depth from the principal longitudinal profile.

In addition to the measurements of dry density plate loading tests may also be carried out. Plate loading tests may be made only when the ground is entirely unfrozen.

Plate loading tests on the carriageway shall be made in general at an interval of 50 ...200 m from each lane alternately. Special circumstances may however call for more effective control.

Testing of Replacement of Soil and Blasting

After replacement of soil by filling, test drilling shall be carried out at an average interval of 20 m from the side of the embankment in order to ascertain how deep the fill has penetrated and to determine if any additional measures are necessary. The settlement of fill materials shall also be investigated, if necessary, by drillings through the embankment (i.e. deep drilling or similar method).

The consumption of fill materials shall be checked, if possible, for each embankment.

In connection with deep blasting, the depth of drilling can be checked to ascertain the depth of excavation or when the rock has been loaded, test pits may be dug at an interval of some 50 m on an average. So much broken rock shall be removed from the test pit as is required to show that the required excavation depth has been reached.

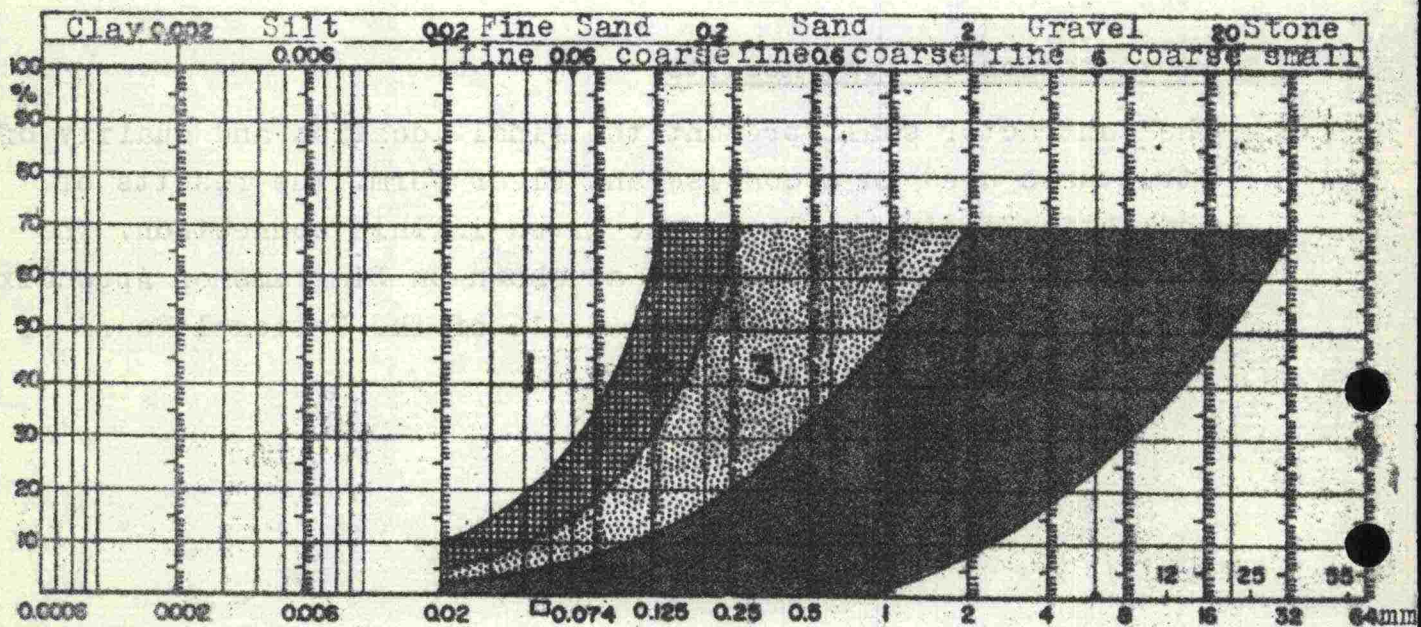
Presentation of Test Results

The Contractor shall present the final location and quality of structures used in a concise and clear form. The results of compaction tests shall also be given in this connection. The method of presentation can be as shown on Diagrams of Appendixes 11...13 of the Publication No. 2.816 of the National Board of Public Roads and Waterways.

All soils whose grading curves lie within Zone 1 are <u>frost-susceptible.</u>

All soils whose grading curves lie within Zones 2, 3 or 4 are <u>frost-resistant</u>, provided that the lower end of the grading curve does not lie above the curve forming the left-hand boundary of the Zone in question.

The degree of frost-susceptibility of a soil can also be determined by reference to its capillarity, soils whose capillarity is less than 100 cm being frost-resistant.



A. Rock

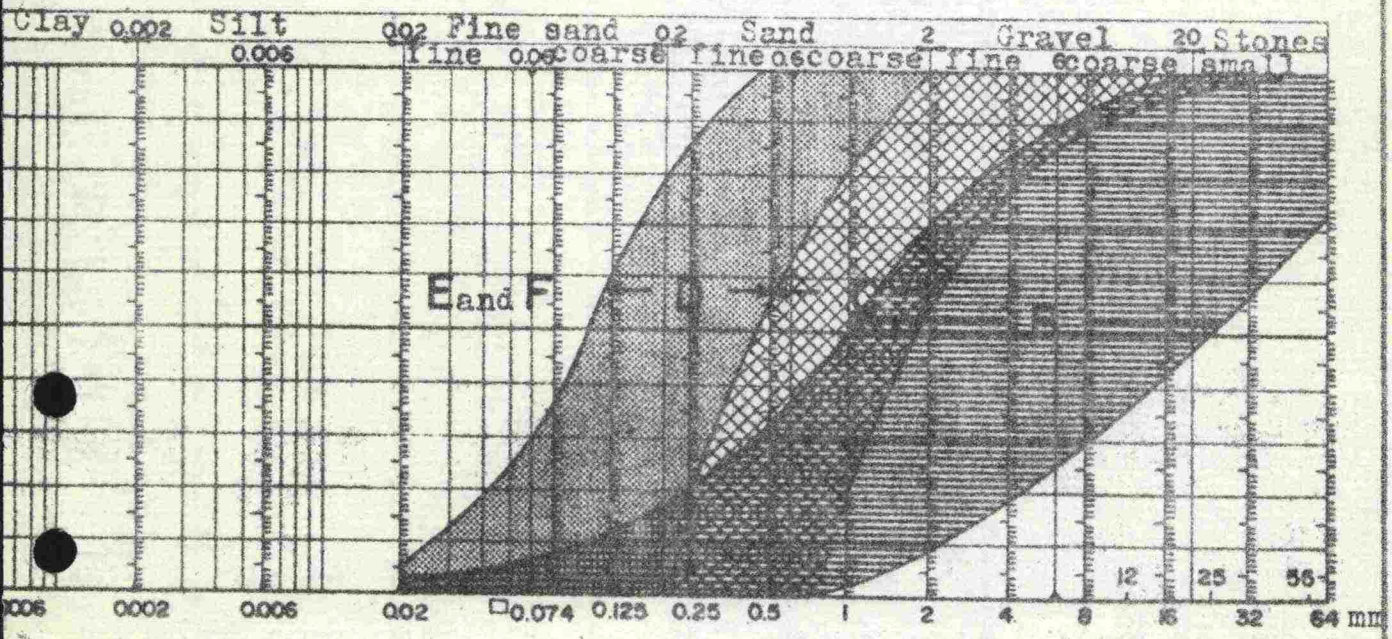
B. Frost-resistant soil types with the gradation curve within design zone B, or soil types with coarser grading.

C. Frost-resistant soil types with the gradation curve within design zone C.

D. Frost-resistant soil types with the gradation curve within design zone D.

E. Frost-susceptible soil types, excluding those included in category F : dry crust clay, frost-susceptible fine sand and frost-susceptible moraine types.

F. So-called weak soil types such as very weak clay, peat, mud and silt and soil types of category E, if drainage or other conditions are poor.



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REINSTATEMENT OF SITE

Prior to the end of the work the Contractor shall clear and tidy up all areas with surroundings used for construction or other purposes during the work.

All construction roads shall be repaired. Camp areas shall be tidied up. Refuse from construction work, foundations of huts, crushing or other plants shall be removed. The floors of stock-pile areas, borrow pits and tips shall be cleaned. All visible and unsightly parts of buildings and structures even outside the road area shall be removed and levelled. All timber not intended for permanent use shall be removed. Ground surfaces upheaved in an unsightly manner during foundation work shall be levelled and reinstated by suitable method.